ORIGINAL ARTICLE

Effects of KID SMART FOR TEETH Program to Promote the Oral Health Status Among Grades 4-6 of Elementary Schools in the Thai-cambodian Border Provinces of Thailand

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ABSTRACT

Introduction: The oral health problems of children have a significant impact on their physical development and learning abilities. Children in the Thai-Cambodian border area have a higher incidence of oral health problems compared to other levels. This quasi-experimental study aimed to investigate the KID SMART FOR TEETH program's effects on promoting oral health status among grades 4-6 elementary schools in the Thai-Cambodian border province of Thailand **Materials and methods:** Using purposive sampling, the samples were recruited from 70 respondents, and divided into the intervention group (n=35) and the control group (n=35). The intervention group received the intervention program, while the control group received a self-care oral health manual. The evaluation was performed through face-to-face interviews in baseline and three-month follow-up. Data analysis was used with descriptive statistics, paired t-tests, and independent t-tests. **Results:** The finding indicated statistically significant differences in the mean score of knowledge, effective toothbrushing behavior, and Debris Index (DI) between the intervention and control groups at three-month follow-up ($p<0.001$). Interestingly, the mean score of attitudes toward oral health care was not statistically significant differences compared between groups at three-month follow-up ($p=0.374$). Compared with baseline and three-month follow-up, the within-group comparison revealed that all of the parameters were statistically significantly different ($p<0.001$) in the intervention group. **Conclusion:** This finding demonstrates that the intervention can increase knowledge and promote effective toothbrushing behavior, leading to good oral health. Additionally, health personnel and schools can apply this program to plan for addressing children's oral health.
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Keywords: Oral health status, Teeth, Thai-Cambodian border, Children, Debris index

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INTRODUCTION

Children today have changed, leading lives increasingly fraught with health risks, including lack of exercise, a preference for consuming snacks and carbonated drinks, and neglecting personal health care, all stemming from inappropriate behaviors (1, 2). Consequently, children are at greater risk of health hazards, particularly tooth decay, which significantly impacts their overall health (3). The dental problems of dental caries and periodontal disease in children can have a significant impact on their physical development (4). Dental caries issues during childhood can lead to long-term damage to the chewing system. Moreover, if children neglect their oral health, problems can accumulate and become more severe as they grow older (5). Therefore, it is crucial to establish an appropriate oral health promotion system for children in this age group to lay the foundation for good oral health in the future (6, 7). It is essential to address dental health issues in children through structured learning processes and practical training to enhance toothbrushing skills and modify health behaviors (8). This includes effective methods for preventing dental caries and periodontal disease (9,10).

According to the 8th National Oral Health Survey of Thailand in 2017, 52.0% of 12-year-old children suffer

from dental caries, with 31.5% of them having untreated dental caries. Moreover, 66.3% of the children have periodontal disease. As for their toothbrushing habits, 86.5% of them brush their teeth every morning after waking up, while 13.3% brush after lunch, and 31.4% brush after lunch at school every day (11). Additionally, the results of the oral health survey in Sa Kaeo province, a border province between Thailand and Cambodia, in 2023 revealed that among children under 12, 12.4% had untreated decayed permanent teeth. When examining by district, specifically in Watthana Nakhon district, Sa Kaeo province, it was found that 17.43% of children had untreated decayed permanent teeth. When considering the Nong Makkeng sub-district, the results of oral health examinations among students in grades 4-6 revealed that there were untreated decayed permanent teeth at a rate of 28.36%, and the prevalence of periodontal disease was 29.10% (12). It was observed that among students in grades 4-6, those in the Nong Makkeng sub-district have the highest percentage of untreated decayed permanent teeth when compared to other districts and provinces at the national level.

The study was focused on children in grades 4-6, typically aged 10-12 years. At ages 10-12, children are at a cognitive stage where they can understand more complex concepts and instructions. They can grasp the importance of oral hygiene, the reasons behind dental care practices, and the long-term benefits of maintaining good oral health. This age range is crucial for habit formation. Children are still developing their daily routines, making it an ideal time to introduce and reinforce good oral hygiene practices. Children in grades 4-6 are generally eager to learn and are more engaged in educational activities (6). This age group is at a pivotal point where effective oral health education can significantly improve their immediate and long-term oral health status (9).

Based on the information provided, it is evident that students in grades 4-6 in the study area have a higher occurrence of oral health issues compared to other grade levels (12). This trend has been continuously increasing. Additionally, surveys conducted by health agencies in the area have revealed that children's toothbrushing behavior, consumption of sugary foods, and personal dental hygiene have all been deemed inadequate (13). Additionally, most students in the border province of Thailand-Cambodia predominantly reside with grandparents as their parents work locally or have migrated to urban areas, possibly lacking rigorous guidance regarding appropriate oral health behaviors. (14).

Children aged 10-12 years are at a stage in their development where they increasingly engage in various activities, such as playing, socializing, and using electronic devices and social media. (15). Children in this age group are becoming more independent and self-reliant. They start valuing peer interactions more, spending considerable time with friends either in person or online. This is the age when children are likely to start using smartphones, tablets, and other electronic devices. Additionally, they might be influenced by peers or social media trends to consume sugary drinks or snacks, which can harm their oral health (16). Therefore, it's crucial to promote and focus on preventive efforts to reduce the risk of oral health problems that may increase significantly in the future.

The objective of this study was to assess the effects of the KID SMART FOR TEETH program in enhancing the oral health of 10-12-year-old students in grades 4-6 at elementary schools located in the Thai-Cambodian border province of Thailand. The program was designed to enhance knowledge of dental cavities and periodontal disease, cultivate a positive attitude toward oral healthcare, and encourage effective toothbrushing behavior to reduce the Debris Index (DI). The study's results can reduce oral disease incidence caused by poor behavior and offer long-term preventive measures to lessen dental problems in children.

MATERIALS AND METHODS

Study design, population, and samples

This study was a quasi-experimental research design with a repeated measure design for two groups to compare the knowledge about dental caries and periodontal disease, attitudes towards oral health care, effective toothbrushing behavior, and Debris Index (DI) mean scores between the intervention and control groups at baseline and three-month follow-up. Additionally, the study aimed to compare the outcomes within the intervention group at baseline and three-month follow-up. The intervention group received the KID SMART FOR TEETH program for five weeks, with one session per week, while the control group received a self-care oral health manual over the same five-week duration, designed for continuous follow-up in three months. Data were collected twice, at baseline and the three-month follow-up measurements for both the experimental and control groups. The research was conducted between December 2023 and March 2024.

The population of students enrolled in grades 4-6, typically aged 10-12 years, in the Nonmakkeng sub-district, Sa Kaeo province during the first semester of the academic year 2023, consisted of 157 females and males. The sample size was calculated using G*Power software, with an effect size of 0.68 (17), an alpha value of 0.05, a power of study (Beta) of 0.80, and an allocation ratio of N2/N1 of 1. From the calculation, both the intervention and control groups comprised 35

participants, totaling 70 participants.

The sampling technique, inclusion, and exclusion criteria

The participants in this study were selected using purposive sampling and assigned to either the intervention or control group. The sampling process was as follows: The sub-district of Nonmakkeng is situated along the Thai-Cambodian border and is divided into four schools. Researchers chose one school for the intervention group and one school for the control group, based on oral health examination data of students. Among the four schools, Ban Thap Mai School and Pracha Kaset Phatthanakan School had the highest incidence of oral health issues, ranking as the top two schools. In Prachakaset Phatthana School, 27.3% of students had untreated decayed permanent teeth, and the prevalence of periodontal disease was 35.13%. At Ban Thap Mai School, the rate of untreated decayed permanent teeth was 34.92%, and the prevalence of periodontal disease was 33.33% (12). Therefore, Ban Thap Mai School was selected as the intervention group, and Pracha Kaset Phatthanakan School was chosen as the control group. Both schools had similar demographic characteristics among their student populations, including lifestyles and oral health behaviors. Subsequently, 35 participants were selected for each group, based on inclusion criteria shown in Figure 1.

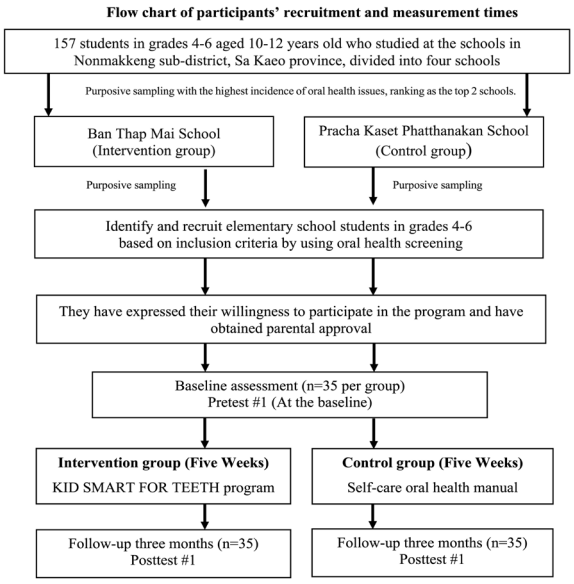

Figure 1: Expansion of the flow chart of participants' recruitment and measurement times, can be seen in sampling the participants from the population. The participants were selected using purposive sampling and assigned to the intervention and control groups based on the highest incidence of oral health issues, ranking as the top 2 schools. After three months of follow-up, all participants continued their involvement in the intervention program and underwent measurement procedures.

The criteria for inclusion in the program were as follows: students in grades 4-6, attending schools affiliated with the Nonmakkeng sub-district, aged between 10 and 12 years old, with oral health screening scores of levels one or seven according to the class-level dental health examination record, and who expressed a willingness to participate in the program and obtained parental consent. The exclusion criteria include students with health problems who cannot participate in the program as well as students who have not fully participated in the program activities or whose parental consent has been withdrawn.

Intervention procedures

The intervention program was developed by the researcher based on the KAP model (18). This model is a framework used to understand and evaluate the components that influence individuals' behavior. This study was focused on an understanding of dental caries and periodontal disease by educating them about the causes, symptoms, prevention, and treatment of these oral health issues. Moreover, this was addressed to improve attitudes towards oral health care and the importance of maintaining good oral hygiene. Consequently, this program was designed to promote the adoption of effective toothbrushing behavior and overall oral hygiene practices. The KAP model interventions can be designed to enhance knowledge, shape positive attitudes, and ultimately influence practices toward better oral health.

To ensure the program's sustainability and add crucial content, community participation was incorporated into the intervention. The process of community engagement involved conducting focus groups with stakeholders such as children, parents, and teachers, who were involved in the development and design of the intervention. The essential content gathered from the focus groups was then incorporated into the intervention draft, which was originally designed based on theory and literature review.

The draft was submitted to five experts for content validity assessment for intervention using the Content Validity Index (CVI). A panel of five experts is considered sufficient to provide a diverse range of perspectives. The guideline cited for determining the number of experts was Lynn's method (19), which recommended a panel of three to ten experts for content validity assessment with 10 items. The five experts were chosen based on their relevant disciplines and specialties, including dentists, educators' specialists, public health specialists, pediatric nurses, and behavioral scientists. After assessing the Content Validity Index (CVI) of the intervention program, it was found to be 0.94, indicating excellent content validity at the scale. Based on expert comments, the researcher revised the program details and implemented the intervention program.

The "KID SMART FOR TEETH" program was designed to focus on providing knowledge about dental and periodontal diseases, reinforcing attitudes toward oral health care, and encouraging effective toothbrushing

behavior to promote oral health status (20). This program can promote oral health, leading to individual behaviors such as choosing healthy foods for oral health, acquiring correct tooth brushing skills, and ultimately resulting in strong oral health contributing to robust growth and development. The research team carried out and monitored this intervention, which involved public health staff, dental public health professionals, and teachers. Before implementing the intervention, they received training to familiarize themselves with the program details, measurement methods, and follow-up procedures. During the experimental period, the intervention group took part in the KID SMART FOR TEETH program from the researcher team including public health staff, dental public health professionals, and teachers, which lasted for five weeks. The group attended one session per week, which lasted for 60 minutes.

The control group received a self-care oral health manual, which is different from the KID SMART FOR TEETH program. This standard manual was created by the Bureau of Dental Health, Department of Health to promote oral health in children for dental projects at primary healthcare units. It covers basic knowledge of oral health care, teeth and dental caries, gingivitis, and periodontal disease. It also includes information on the impact of food on dental health, the consequences of neglecting oral health, the benefits of maintaining oral health, proper tooth brushing techniques, selection of oral cleaning products, methods of brushing the upper and chewing surfaces of teeth, methods of brushing the lower teeth and tongue, the 2-2-2 tooth brushing rule, principles of using dental cleaning products, and self-examination of teeth.

The program activities were designed to be diverse and appropriate for children's learning and lifestyles. The activities included formal dental health education on topics such as oral health, oral diseases, symptoms, risk factors, and oral health care and prevention, using PowerPoint presentations. Also, the activities consisted of group discussions, goal-setting for good oral health, raising awareness through role models by video learning, game-based learning to improve oral healthcare, practicing self-examination of the oral cavity, and brainstorming. All of the activities in each session effectively improved knowledge, enhanced awareness, promoted effective toothbrushing behavior, and reduced Debris Index (DI). The intervention program included a series of S-M-A-R-T activities, and the process and details of these activities were as follows:

S: Stimulate the knowledge to enhance understanding of dental and periodontal diseases. The researchers introduced themselves and explained the objectives of the intervention program. Following that, an ice-breaking activity was conducted using gaming to brainstorm ideas, express opinions, and select a group representative to share the learning with the participants. Furthermore, the participants received formal dental health education on topics such as oral health, oral diseases, symptoms, risk factors, and oral health care and prevention, using PowerPoint presentations.

M: Motivate attitudes to reinforce attitudes towards oral health care. The researchers utilized video learning to educate participants about children's oral health care and provided them with Post-it notes. They shared their opinions on three topics: good oral health behavior, poor oral health behavior, and ways to improve good oral health behavior. Each topic was written on a different colored Post-it note: green, red, and blue, respectively. These were then shared and discussed their opinions. Moreover, the attitude enhancement activity was carried out to promote attitudes toward food affecting oral health, both positively and negatively, through a food model. Representatives from the participant group were assigned to classify food categories and set goals for achieving good oral health. The activity was designed to be engaging, allowing students to share and discuss their opinions. Moreover, the researcher implemented strategies such as Think-Pair-Share. These involved students contemplating a question independently, discussing it with a partner, and ultimately sharing their thoughts with the entire group. Consequently, the researchers effectively ensured that students aged 10-12 years old were able to express their opinions on behaviors.

A: Activate proper oral health behavior to promote oral health behavior. The researchers implemented a learning activity on oral health care skills through a Walk Rally activity, divided into two bases: Base one focused on proper tooth brushing techniques and flossing. In contrast, Base Two emphasized self-examination of oral health with seven steps. Additionally, we instructed the participants to chew disclosing tablets and practice proper tooth brushing skills. Subsequently, the researcher assessed the effectiveness of tooth brushing using disclosing tablets to stain the plaque remaining on the tooth surfaces, making it easier to see and evaluate how well the teeth were brushed. Disclosing tablets can help to understand and see the effects of inadequate brushing clearly. Children with the most effective tooth brushing results were selected for award distribution.

R: Raise awareness to raise awareness for preventing dental caries and gingivitis. The researcher conducted a game activity involving running to match pictures of dental caries and gingivitis disease. The students were divided into two groups to play a matching game, where they matched pictures to the meanings of dental caries and gingivitis. They participated in a relay race, with one student running simultaneously. The group that finished first with the most correct matches was declared the winner. Additionally, the sample group was paired up to conduct oral health check-ups and exchange dental

examination information with each other, subject to verification by the researchers before returning the data to the parents.

T: Talk to plan to stimulate motivation for good oral health care behaviors through the exchange of opinions and the joint planning of action steps. To ensure that students in grades 4-6 can effectively summarize problems, obstacles, and solutions. Because, the researchers conducted an opinion exchange activity between the researchers, teachers, and children by dividing them into two groups for brainstorming. Have researchers or teachers actively support and guide the discussions. They can ask probing questions, provide hints, and ensure that the conversation stays on track. Offer regular feedback and encouragement. This helps validate students' contributions and provides opportunities for improvement. Afterward, each group representative then presented and exchanged learning between groups. Afterward, the researchers summarized the problems, obstacles, and solutions. Following that, agreements were made to promote oral health together, including announcing agreements or setting policies for promoting oral health jointly with schools, parents, and communities. After that, the researchers organized regular meetings and workshops with teachers, school administrators, parents, and dental health professionals to discuss the program's goals, activities, and progress.

This study involved a three-month follow-up period after the experiment. Monitoring was conducted monthly at both the experimental and control group. Additionally, class teachers were assigned to monitor tooth brushing records and encourage consistent practice. The class teachers used a logbook to record each student's daily tooth-brushing activity. This log was periodically reviewed to assess consistency and frequency. The teachers also conducted random checks to ensure that students were indeed brushing their teeth as recorded. Tooth brushing sessions were scheduled at specific times during the school day, such as after lunch, to ensure that all students brushed their teeth at the same time, making monitoring easier. In addition, involving parents to remind and encourage their children to brush their teeth at home can complement the school's efforts and promote consistency. This follow-up method can effectively measure, schedule, and ensure consistent tooth-brushing practices among students. After three months, the researcher assessed various variables using interviews and examined oral health status using the Debris Index (DI). Furthermore, awards were given to the top three students who took the best care of their teeth, with certificates of honor presented to students in both the experimental and control groups.

Instrument of the study

The research tool was developed based on theories (18) and research relevant to oral health status (24, 25, 26). The measurement form consisted of five parts as follows: Part 1: The baseline characteristics interview form consisted of seven questions in both open-ended and closed-ended formats. The tool was developed by researchers and consisted of questions including gender, age, characteristics of living, received money to school, times brushing teeth per day, student counselor with teeth, and foods at risk for tooth decay in schools.

Part 2: The knowledge assessment questionnaire on dental caries and periodontal disease. This instrument was created by reviewing theories (18) and relevant literature (24). The tool comprised 15 questions with response options of “correct” or “incorrect”. Each correct answer scored one point, while each incorrect answer scored zero points. Score interpretation was categorized into 3 levels based on Boom's criteria (21): scores of 0-8 indicated low knowledge, 9-11 indicated moderate knowledge and scores of 12-15 indicated high knowledge of dental caries and periodontal disease.

Part 3: The attitude measurement questionnaire on oral health care consists of ten questions. This tool was developed after reviewing theories (18) and relevant literature (25). The questions were designed on a Likert scale with three levels: agree, unsure, and disagree. The questions included positive and negative aspects, with scoring criteria of 3, 2, and 1 for positive questions and the opposite for negative ones. Score interpretation was divided into three levels according to Best's criteria (22): mean scores ranging from 1.00 to 1.66 indicated low attitudes, mean scores from 1.67 to 2.33 indicated moderate attitudes, and mean scores from 2.34 to 3.00 indicated high attitudes toward oral health care.

Part 4: The assessment form for effective toothbrushing behavior comprised ten questions. This instrument was created by reviewing theories (18) and relevant literature (26). The questions were designed on a Likert scale with three levels: regular, occasional, and never. Questions encompassed positive and negative aspects, scoring criteria of 3, 2, and 1 for positive questions, and the opposite for negative questions. Scores were divided into 3 levels according to Best's criteria (22): scores ranging from 1.00 to 1.66 indicated poor behavior, 1.67 to 2.33 indicated moderate behavior and 2.34 to 3.00 indicated good behavior for proper toothbrushing.

Part 5: The Debris Index (DI) assessment form measures oral health examination using the debris index developed by Greene and Vermillion (23). The examination involves using a mouth mirror to visually inspect the mouth and searching for soft debris on the teeth. The examiner evaluates specific tooth surfaces for the presence of debris. Typically, these surfaces include the buccal (cheek side), lingual (tongue side), and occlusal (biting surface) surfaces of a select number of teeth. A scoring method is employed to classify the number of debris observed on each tooth's surface during examination. The scoring criteria are as follows:

Score 0 indicates no visible debris or soft deposits, Score 1 indicates soft debris covering up to one-third of the tooth surface, Score 2 indicates soft debris covering more than one-third but not more than two-thirds of the tooth surface, and Score 3 indicates soft debris covering more than two-thirds of the tooth surface. The Debris Index (DI) is calculated by averaging the scores obtained from all tooth surfaces examined and then dividing by the number of surfaces examined. The scoring criteria for assessment were divided as follows: a mean score of 0.0 to 0.6 indicated minimal bacterial plaque, suggesting low oral health status; a mean score of 0.7 to 1.8 indicated moderate bacterial plaque, suggesting moderate oral health status; a mean score of 1.9 to 3.0 indicated high bacterial plaque, suggesting high oral health status.

The research instruments were assessed by three experts from the fields of dentistry, nursing, and public health. Their Item Objective Congruence (IOC) scores were all greater than 0.95 in parts 1 to 5 of the instruments. Additionally, to assess reliability, a pilot study was undertaken, utilizing a particular instrument to collect data. Thirty children with comparable traits to the participants were enlisted for this pilot study. The reliability of the knowledge questionnaire on dental caries and periodontal disease, assessed using the Kuder-Richardson 21 (KR-21) method, was found to be 0.92. Additionally, the Cronbach's alpha coefficient exceeded 0.90 in the attitude measurement questionnaire, effective toothbrushing behavior assessment form, and debris Index (DI) assessment form.

Data collection

Before the experiment, the researchers coordinated with the schools for the intervention and control groups. They obtained permission from the school administrators to conduct the study, collect data, evaluate the research outcomes, and carry out the experiment. The screening was conducted according to the specified inclusion criteria. The data was collected through face-to-face interviews conducted by researchers and assistant researchers. Before the data collection, all interviewers received standardized training for the interview questions. Research data were collected at the baseline measurement of both the intervention and control groups. One sample was taken for 30 minutes to assess the measurement form. This study designed a three-month follow-up period after the experiment. After 3 months, the researcher assessed various variables using the same measurements as at baseline.

Ethical approval

The human research component of this study received approval from the Research Ethics Committee on Human Research at Valaya Alongkorn Rajabhat University under the Royal Patronage in Pathum Thani province. The project was assigned identification numbers REC No 0080/2023 and COA No 0080/2023, and it received certification on December 20, 2023.

Data analyzing

The data analysis was performed using SPSS version 29.0.1, with a significance level set at 95%. Descriptive statistics were employed to outline the characteristics of the variables. Frequency and percentage were used to describe categorical variables, while mean and standard deviation were used to define numerical variables. The Kolmogorov-Smirnov goodness of fit test was utilized to assess the normality of outcome variables, revealing that all dependent variables exhibited a normal distribution. Moreover, the difference in mean scores between and within groups at baseline and the three-month follow-up was examined through the independent t-test and paired t-test, respectively.

RESULTS

Baseline characteristics variable between the intervention and control group

This study involved 70 participants in total, evenly divided between the intervention group (n=35) and the control group (n=35). After three months of follow-up, all participants continued their involvement in the intervention program and underwent measurement procedures. As illustrated in Table I, the baseline parameters exhibited comparability across both groups. The findings indicate that the baseline characteristics were similar between the two groups ($p>0.05$). The results indicated that the mean age was 10.9 years (SD = 0.94), with a higher percentage of females (54.3%). The majority (42.9%) resided with their grandparents and had a mean school expense of 29.1 baht (SD = 12.3). Furthermore, the majority of participants (42.9%) reported brushing their teeth once daily and consulting their parents when experiencing dental issues (72.9%). Additionally, 92.9% of the school environment contained foods posing a risk for tooth decay.

Table I: The baseline characteristics data of each respondent group (n=70)

Variables	Total n (%)	Intervention group n (%)	Control group n (%)	p-value
Age (Years)				
Mean± SD.	10.9±0.94	10.6±0.73	11.0±0.79	0.310[c]
Gender				
Female	38 (54.3)	21 (60.0)	17 (48.6)	0.337[a]
Male	32 (45.7)	14 (40.0)	18 (51.4)	
Characteristics of living				
Grandparents	30 (42.9)	15 (42.9)	15 (42.9)	0.103[b]
Parents	25 (35.7)	13 (37.1)	12 (34.3)	
Mother	7 (10.0)	3 (8.6)	4 (11.4)	
Father	6 (8.5)	2 (5.7)	4 (11.4)	
Relatives	2 (2.9)	2 (5.7)	0 (0.0)	
Received money to school				
Mean± SD.	29.1±12.3	30.1±13.9	28.9±12.1	0.192[c]

CONTINUE

Table I: The baseline characteristics data of each respondent group (n=70). (CONT.)

Variables	Total n (%)	Intervention group n (%)	Control group n (%)	p-value
Received money to school				
Mean± SD.	29.1±12.3	30.1±13.9	28.9±12.1	0.192[c]
Times brushing teeth per day				
Sometimes	24 (34.3)	15 (42.9)	9 (25.7)	0.397[b]
1 time	30 (42.9)	14 (40.0)	16 (45.7)	
2 times	4 (5.7)	1 (2.9)	3 (8.6)	
3 times	12 (17.1)	5 (14.2)	7 (20.0)	
Student counselor with teeth				
Parents	51 (72.9)	26 (74.3)	25 (71.4)	0.352[b]
Classroom teacher	16 (22.9)	7 (20.0)	9 (25.7)	
Relatives	3 (4.2)	2 (5.7)	1 (2.9)	
Foods at risk for tooth decay in schools				
Yes	65 (92.9)	34 (97.1)	31 (88.6)	0.356[a]
No	5 (7.1)	1 (2.9)	4 (11.4)	

Observation: [a]Chi-square test, [b]Fischer's Exact test, [c]Independent sample t-test, significant difference $p < 0.05$

Level of outcome variables of the participants in the intervention and control group Table II demonstrates that most of the participants in the intervention group had a low level of knowledge about dental caries and periodontal disease (77.1%). Progressively, in the three-month follow-up, most of them had changed their knowledge from a low to a high level (94.3%). While most of the participants in the control group reported that their knowledge had remained at a low level at baseline and the three-month follow-up (62.9% vs. 57.1%). Additionally, the majority of participants in the intervention group had a moderate level of attitudes toward oral health care at baseline (62.9%) and changed to a high level at the three-month follow-up (71.4%). While most of the participants in the control group had changed their attitudes from low to moderate levels compared to baseline and the -month follow-up (60.0% vs. 71.4%). Moreover, most of the participants in the intervention group had a moderate level of effective toothbrushing behavior at baseline (71.4%) and changed to a high level at the three-month follow-up (74.3%). The participants in the control group mostly had a moderate level of proper toothbrushing behavior at baseline (54.3%) and maintained a moderate level at the three-month follow-up (62.9%). Interestingly, the majority of the respondents in the intervention group had a high level of Debris Index (DI) at baseline (62.9%) and decreased to a low level at the three-month follow-up (68.5%). On the other hand, the samples in the control group mostly had a high level of Debris Index (DI) at baseline (62.9%) and remained at a moderate level at the three-month follow-up (68.6%).

Table II: Level of outcome variables of the participants in the intervention and control group at baseline and 3-month follow-up (n=70)

Outcome variables	Time	Level	Group	
			Interven-tion n (%)	Control n (%)
Knowledge about dental caries and periodontal disease	Baseline	Low	27 (77.1)	22 (62.9)
		Moderate	8 (22.9)	11 (31.4)
		High	0 (0.0)	2 (5.7)
	3-month follow-up	Low	0 (0.0)	20 (57.1)
		Moderate	2 (5.7)	11 (31.4)
		High	33 (94.3)	4 (11.5)
Attitudes towards oral health care	Baseline	Low	0 (0.0)	0 (0)
		Moderate	22 (62.9)	21 (60.0)
		High	13 (37.1)	14 (40.0)
	3-month follow-up	Low	0 (0.0)	1 (2.9)
		Moderate	10 (28.6)	9 (25.7)
		High	25 (71.4)	25 (71.4)
Effective toothbrush-ing behavior	Baseline	Low	5 (14.3)	3 (8.6)
		Moderate	25 (71.4)	19 (54.3)
		High	5 (14.3)	13 (37.1)
	3-month follow-up	Low	0 (0.0)	1 (2.9)
		Moderate	9 (25.7)	22 (62.9)
		High	26 (74.3)	12 (34.2)
Debris Index (DI)	Baseline	Low	0 (0.0)	0 (0.0)
		Moderate	13 (37.1)	13 (37.1)
		High	22 (62.9)	22 (62.9)
	3-month follow-up	Low	24 (68.5)	11 (31.4)
		Moderate	10 (28.6)	24 (68.6)
		High	1 (2.9)	0 (0.0)

Effects of the KID SMART FOR TEETH program between groups

Table III indicated that at the beginning, there was no significant difference in the mean change of knowledge about dental caries and periodontal disease, attitudes toward oral health care, effective toothbrushing behavior, and Debris Index (DI) between the intervention group and control group at the baseline ($p>0.05$). Consequently, the mean change in all dependent variables was measured between groups after the three-month follow-up. The results showed that there was an increase in knowledge about dental caries and periodontal disease, effective toothbrushing behavior, and a decrease in the Debris Index (DI) in the intervention group compared to the control group ($p < 0.001$) after the three-month follow-up. Therefore, there were no statistically significant differences in the mean score of attitudes toward oral health care between the intervention and control groups at the three-month follow-up ($p=0.374$).

Table III: Comparison of the mean between the intervention group and control group for all parameters (n=70)

Variables	Baseline (Mean± SD.)	3 months follow-up (Mean± SD.)	p-value (a)
Knowledge about dental caries and periodontal disease			
Intervention group	7.06± 2.04	14.03± 1.15	<0.001
Control group	7.66± 2.47	8.03± 2.56	0.544
p-value (b)	0.272	<0.001	
Attitudes towards oral health care			
Intervention group	22.69± 2.47	24.97± 2.63	<0.001
Control group	23.00± 1.85	24.37± 2.97	0.018
p-value (b)	0.549	0.374	
Effective toothbrushing behavior			
Intervention group	21.17± 3.47	24.63± 2.17	<0.001
Control group	22.09± 3.36	22.42± 3.28	0.680
p-value (b)	0.010	<0.001	
Debris Index (DI)			
Intervention group	1.91± 0.38	0.64± 0.40	<0.001
Control group	1.97± 0.46	0.95± 0.39	<0.001
p-value (b)	0.527	<0.001	

Observation: paired t-tests were used to assess the data within each group (p-value (a)) and independent t-tests between groups (p-value (b)).

Effects of the KID SMART FOR TEETH program within the group before and after

When comparing the parameters in the intervention group at baseline and the three-month follow-up, it was determined that there were statistically significant increases in knowledge about dental caries and periodontal disease, attitudes toward oral health care, and effective toothbrushing behavior ($p<0.001$), and there was a statistically significant decrease in the Debris Index ($p<0.001$). Furthermore, when comparing all measures in the control group at baseline and the three-month follow-up, it was demonstrated that there were statistically significant increases in attitudes towards oral health care ($p=0.018$), and there were statistically significant decreases in the Debris Index ($p<0.001$). Additionally, There were no statistically significant differences in the mean score of knowledge about dental caries and periodontal disease ($p=0.544$) and effective toothbrushing behavior ($p=0.680$). (Table III).

DISCUSSION

The summary of findings, it was revealed that knowledge about dental caries or periodontal disease, and effective toothbrushing behavior significantly increased in both groups ($p<0.001$). Additionally, the Debris Index (DI) significantly decreased in both groups ($p<0.001$). Understanding the children's profiles is crucial as these factors significantly influence their oral health. The age and gender of children are important considerations. Younger children may lack the hand coordination needed for effective toothbrushing, while older children may have better-developed motor skills. Additionally, most of the samples were male (54.3%), which may also impact oral health practices due to differences in habits and attitudes towards oral hygiene between males and females. In addition, children who live with parents who prioritize oral health are more likely to have better toothbrushing habits. On the other hand, children living with grandparents or other relatives may have varying levels of supervision and support for their oral hygiene. A significant portion of the sample (42.9%) resided with their grandparents. Children from higher socioeconomic backgrounds usually have better access to dental care and preventive services, leading to improved oral health outcomes. Conversely, children from lower socioeconomic backgrounds may face financial barriers that hinder their access to dental care, resulting in poorer oral health. The findings indicated that most students came from low socioeconomic status, which affected their financial resources for school. Based on the initial results, it was found that there were no significant differences in the mean age, gender, living conditions, and financial support for schooling ($p>0.05$) between the intervention and control groups. This implies that there were no notable variations in age, gender, living conditions, and socioeconomic status between the intervention and control groups.

After the three-month follow-up, the study found that the intervention group had a higher mean knowledge score about dental caries and periodontal disease than the control group. The findings of this research were in line with Somnuk et al. (24) demonstrated that students in the intervention group exhibited significant improvements in their knowledge scores compared to those in the control group ($p<0.001$). Similarly, Swe et al. (25) found that the intervention was found to significantly improve the sustainability of correct knowledge among the intervention group ($p<0.001$). This finding may explain that the KID SMART for TEETH program aimed to improve children's oral health through effective implementation of knowledge based on the KAP model (18). The program was specifically designed to teach children about dental caries and periodontal disease. The participants were provided with formal education on dental health, covering topics such as oral health, oral diseases, symptoms, risk factors, and oral health care and prevention, through the use of PowerPoint presentations. In addition, this intervention utilized interactive learning methods such as games, quizzes, and multimedia presentations can engage children and enhance their understanding of dental health concepts (26, 27). So, the activities can make learning about dental health fun and memorable, leading to better retention of information and can enhance the knowledge after 3 months follow-up.

Therefore, the program has proved to be effective in improving effective toothbrushing behavior even three months after its implementation. Similarity to Nguyen et al. (28) found that school-based oral health education improved the oral health behavior of

Vietnamese adolescents in the intervention group ($p < 0.05$) compared to the control group and Chomchome et al. (29) indicated that the Dental Health Education Program can significantly improve practice for preventing gingivitis ($p<0.05$). It could be explained that this program offers hands-on demonstrations of proper toothbrushing techniques, emphasizing key steps such as using the right amount of toothpaste, brushing in circular motions, and reaching all surfaces of the teeth. The program incorporates game-based learning activities such as walk rallies and running to match picture games, making learning fun and encouraging active participation (30). Additionally, the program emphasizes the importance of regular dental check-ups to assess dental caries, raise awareness, reinforce learning, and provide a reference for children to follow when brushing their teeth at home. Positive reinforcement and rewards for good toothbrushing behavior can motivate children to maintain consistent habits (31, 32). Simple rewards such as stickers, certificates, or praise can encourage children to brush their teeth regularly. Conclusively, the KID SMART for TEETH program can promote effective toothbrushing behavior and lead to better oral health outcomes and reduced risk of dental problems.

The KID SMART for TEETH programs effectively reduced the Debris Index (DI) when comparing the intervention and control groups. The findings aligned with those of Hartwig et al. (33), who reported that an oral health educational intervention resulted in a notable reduction in the debris index within the intervention group compared to the control group ($p<0.05$). Similar to Zarabadipour et al. (17) indicated that the dental plaque index was significantly different before and after training ($p<0.001$) and in line with Ozoemena et al. (4) demonstrated that the mean plaque score for school children was significantly reduced after intervention ($p=0.001$). This finding might explain that; Firstly, this intervention was developed through the KAP model (18), which was designed to focus on providing knowledge about dental and periodontal diseases, reinforcing positive attitudes towards oral health care, promoting effective toothbrushing behavior, and encouraging changes in toothbrushing behavior to create a comprehensive approach to improving oral hygiene. By addressing multiple aspects of oral health, the program may have a more significant impact on reducing the DI (34, 35). According to the KAP model (18), behavior change can be achieved by following three steps (36). The first step is to acquire knowledge, followed by developing attitudes based on that knowledge, and finally, translating those attitudes into practice or action. Secondly, the structured intervention: The intervention group engaged in the program over five weeks, attending weekly sessions that lasted 60 minutes each. This structured approach allowed children ample time to learn oral health concepts, practice toothbrushing techniques, and receive positive reinforcement, resulting in a decrease in DI over time (37).

The Debris Index (DI) is a dental measurement used to evaluate the amount of plaque and debris accumulated on tooth surfaces (38). This index serves as an essential indicator of oral hygiene (39). To reduce the Debris Index (DI), it is crucial to emphasize the interconnectedness of knowledge, attitudes, and practical application in driving behavioral change (40). It suggests that merely providing information may not be enough to change behavior, but individuals must also develop positive attitudes toward the desired behavior and actively engage in practicing it. After completing the experimental program, the researchers incorporated collaborative activities to establish an agreement between teachers, school administrators, and other stakeholders. This agreement can significantly enhance the sustainability of the "KID SMART FOR TEETH" program. It is important to develop Memorandums of Understanding (MOUs) or formal agreements that outline the roles and responsibilities of all parties involved, including schools, teachers, dental health professionals, and parents. Establishing clear agreements between all stakeholders can help achieve greater sustainability and long-term success.

At the three-month follow-up, the groups had no significant differences in mean scores of oral health care attitudes. This was not consistent with Tumkaew and Duangsong (41) discovered a significant improvement in attitudes in the experimental group compared to the control group ($p<0.001$). There could be several reasons why the KID SMART for TEETH program may not effectively improve attitudes toward oral health care among children: the program may focus more on providing information or practical skills rather than addressing attitudes and beliefs related to oral health. Children may not be sufficiently engaged or motivated by the program's activities or materials to change their attitudes toward oral health care (42). Moreover, attitudes toward oral health care can be influenced by cultural beliefs, social norms, and family practices (43). If the program does not adequately address or account for these factors, it may struggle to change attitudes toward oral health care among children from diverse backgrounds (44, 45). In summary, the KID SMART for TEETH program's effectiveness in reducing the Debris Index in children can be attributed to its comprehensive approach, community participation, evidence-based design, and structured intervention sessions. The program targeted knowledge, attitudes, and behaviors related to oral health, promoting sustained improvements in oral hygiene and contributing to better oral health outcomes among participants.

The study's recommendations can be used to make suggestions for implementing other aspects. Firstly, the children can apply the experience from the intervention in their daily lives. This will help promote oral health status among children and prevent future occurrences of dental caries and periodontal disease. Secondly, this program can be utilized by public health dentistry

personnel to enhance knowledge and oral care behaviors, with collaboration from school health teachers and parents in the context of each Thai-Cambodian border area. Thirdly, another school in the same region of the Thai-Cambodian border area of Thailand, with similar population characteristics, can also be adapted to promote the oral health status among children. The recommendations for future studies are suggested: Firstly, future research should focus on improving health literacy related to oral health. This will not only enhance knowledge and toothbrushing behavior but also promote a positive and long-lasting attitude toward oral health. The target groups selected both children in grades 4-6 and their parents or primary caregivers. By involving parents, the program can leverage their influence to reinforce and sustain the children's oral health behaviors and attitudes. Children who understand and value the information provided are more likely to implement and sustain recommended practices. Secondly, a mobile application should be developed to educate and promote good oral health behavior among children. This will involve the development of content related to this topic, such as songs, movies, and short clips.

Strengths of this study described that the program was tailored for children in grades 4-6 to ensure that the educational content and activities are suitable for their cognitive and developmental levels. It utilizes engaging and interactive methods such as games, storytelling, role-playing, and visual aids to make learning about oral health fun and memorable. Additionally, hands-on toothbrushing sessions allow children to learn and practice proper brushing techniques, reinforcing good habits. This research also has limitations; selection bias may have been present in this study when selecting the intervention and control groups, as they were recruited from the Thai-Cambodian border area of Thailand, thus making it impossible to demonstrate applicability to other areas. Additionally, the use of a small sample size and purposive sampling may have led to bias, as the findings cannot be easily generalized to the larger population.

CONCLUSION

The study showed that the KID SMART FOR TEETH Program effectively increased children's knowledge about dental health and improved their toothbrushing behavior. It also reduced dental plaque assessed by Debris Index (DI) in the intervention group compared to the control group. However, there was no change in attitudes toward oral health care, indicating that different or additional strategies may be needed to influence attitudes. This highlights the need for comprehensive approaches in oral health programs to address both behavioral and attitudinal aspects. Additionally, schools could play a crucial role in promoting oral health. Integrating such programs into the school curriculum can help establish long-term healthy behaviors.

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