

REVIEW ARTICLE

A Scoping Review on the Educational Strategies Used in Intervention Studies to Improve Oral Health in Children

Siti Sarah Ayub^{1,2}, Mohd Zulkarnain Sinor¹, Sarliza Yasmin Sanusi¹, Basaruddin Ahmad¹

¹ School of Dental Sciences, Health Campus, Universiti Sains Malaysia, Kubang Kerian, 16150, Kelantan, Malaysia

² Oral Health Program, Ministry of Health, Level 5, Block E10, Parcel E, Precinct 1, Federal Government Administrative Centre, 62590 Putrajaya, Malaysia

ABSTRACT

This study reviewed the educational strategies of oral health intervention studies on children aged three to 18 years. Eighteen studies, published between January 2015 and December 2021, were found in the major databases and met the eligibility criteria. Information on the educational activities, topics, and study participants were extracted and synthesised, and the association between the number of strategies and oral health improvement was examined. Demonstrations, distribution of printed materials, and provision of oral health kits were frequently employed educational activities of the 14 studies identified. Of ten topics, oral health care, diet, and oral diseases were frequently included. Most interventions involved children only and few had involved the parents, children, and teachers. Improvement in clinical and non-clinical outcomes are associated with fewer topics and targeting children only, respectively. It is unclear whether mixed and multiple strategies are advantageous and cost-effective in preventing oral diseases in children.

Malaysian Journal of Medicine and Health Sciences (2023) 19(1):307-315. doi:10.47836/mjmhs19.1.39

Keywords: Children, Clinical outcomes, Oral health intervention, Oral health strategies, Scoping review

Corresponding Author:

Basaruddin Ahmad, PhD

Email: basaruddin@usm.my

Tel: +6019 662 7712

INTRODUCTION

Dental caries and gingivitis are prevalent in children and develop as early as infancy (1,2). They can impact daily activities such as eating and sleeping, growth, and cognitive development of the children (3,4) and, burdens on the economy (1); hence, prevention of the diseases in this population should be given precedence. Oral health education is the common approach to providing individuals with a structured learning experience based on evidence for improving knowledge, attitudes, and skills for adopting healthy behaviours (5). It is believed to increase the knowledge and awareness regarding oral health and motivate the adoption and maintenance of good oral health behaviours that will eventually lead to improvement of oral health status. Oral health education strategies encompass a combination of activities and messages, target participants, and educators in delivering the messages (6). Planning health education strategies to achieve the desired learning experiences is a complex process; the

intervention has to match the concerning problem in the population with the educational strategies and the availability of material, manpower, and cost.

Earlier intervention programs that have been developed and trialed in children (7,8) are designed and delivered as a package with mixed strategies; each program includes several activities, oral health topics, and one or more target participants. There is currently limited evidence and discussion on the strategies adopted by the earlier oral health intervention studies. The types of oral health education activities and topics commonly employed by earlier studies are not known. It is also not clear which activity or topic is best or appropriate for a given context of a message; for example, which activity, from the demonstration, lecture, video, and leaflets, is more effective for educating the correct toothbrushing technique? A better understanding of the issue relating to oral health education strategies can benefit oral health professionals in planning and designing an intervention. Hence, the purpose of this scoping review was to describe the oral health educational activities and topics, and the target participants of intervention studies on children and, to assess whether the number of activities, topics, and target participants is related to significant improvement in oral health outcomes.

METHODOLOGY

Identification of relevant studies

This scoping review was conducted based on the method outlined in the Arksey and O'Malley framework (9) and followed the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) statement reporting format (10). This review searched the electronic CENTRAL, Scopus, and PubMed databases using keywords related to population (child*, "young children", adolescent*, teenage*, "schoolchild*", youth), intervention ("oral disease prevention", "oral health promotion", "dental health promotion", "oral health education", nutrition, diet) and outcomes ("dental caries", "periodontal disease*", "gingival index", dmft/DMFT, dmfs/DMFS, "tooth decay", "oral health efficacy", "oral health behaviour*") in the titles and abstracts. The search was limited to studies published between the 1st of January 2015 and the 31st of December 2021.

Eligibility criteria

The initial eligibility criteria included randomized controlled trials (RCTs) or cluster RCTs studies designed to assess the effectiveness of oral health education on children aged three to 18 years in single or multiple study settings, reported in the English language and, the full-text report was accessible. The eligibility criteria were refined as familiarity with the literature was gained during the screening stage. That led to two additional criteria: the studies included at least one clinical outcome (dental caries, gingivitis plaque, or accumulation) with or without non-clinical outcomes and the control group received no intervention or only standard care. Studies with non-clinical outcomes only, including children with special needs, or undergoing orthodontic treatment were excluded. No restrictions were applied on the follow-up duration and the educator who delivered the interventions.

Selection and screening process

Two authors (MZS and SSA) obtained the records and screened the title and abstract for relevant studies. The full text of the reports (n = 48) was then obtained and screened using an eligibility form that summarises the study design, study participant, intervention methods, and outcome measures. All authors were involved in the screening process after a calibration exercise using three randomly selected full-text reports from the included studies. The screening was first done independently by each author and then followed by a team discussion to reach a consensus on whether or not to include a study and to resolve discrepancies between reviewers.

Data abstraction and synthesis

A data abstraction form was used to collect information on the author, title, objective, publication year, country, study population, number and age of participants, study duration, setting, educator, and details of the oral health

strategies (activities, topics, and target group), outcome measures, and statistical findings from the reports. The synthesis process involved charting the strategies employed in each study by the types of activities, topics, and study participants and categorising them based on common themes identified from the keywords and/or descriptions. The labels for the categories were either adapted from McKenzie et al. (6), and Gilbert et al. (11) or derived by the authors. This review defined educational activities as the methods for delivering the educational message to the target participants (6) and the categories were defined by the nature of the activity. For example, the statement "Practical demonstration of brushing techniques was also provided to children..." in Petersen et al. (12) indicated a demonstration, and "...a poster to motivate children to brush their teeth twice daily was hung on the classroom wall during the trial period..." in Samuel et al. (13) indicated an exhibition. An oral presentation with and without the use of additional aids to improve the delivery of the educational message (14) was categorised into separate categories.

A topic is the subject of the educational message delivered in the intervention. For example, the statement "Fresh fruit and vegetables, instead of candy and soft drinks, were suggested to protect the teeth and keep the children healthy" in Wu et al. (15) indicated a topic on diet. The target participants were the individuals who received the intervention (6). Dental caries, gingivitis, and plaque measures were the clinical outcomes, and behavioural (e.g., toothbrushing frequency), knowledge, and attitudinal measures were the non-clinical outcomes. Each study was also classified based on whether it found a significant statistical association with the clinical or non-clinical outcomes. Charting and data abstraction was performed by one author (SSA) and then reviewed individually and in a group discussion. Any discrepancy and disagreement were discussed and resolved in group discussion.

Statistical analysis

The Chi-squared test was used to examine whether the number of strategies used in an intervention influenced the study outcome (finding at least one statistically significant clinical or non-clinical outcome).

RESULTS

Included studies

A total of 765 records from searches in databases and 19 records from hand searches in other articles were found; of that, 321 duplicate records were removed (Figure 1). From the remaining 463 records screened based on the title and abstract, 415 were excluded due to not meeting the eligibility criteria. Then, from the 48 full-text articles retrieved and screened, a total of 30 studies were excluded for using observational or non-randomized interventional study design (n = 22), targeting the intervention at parents only (n = 1),

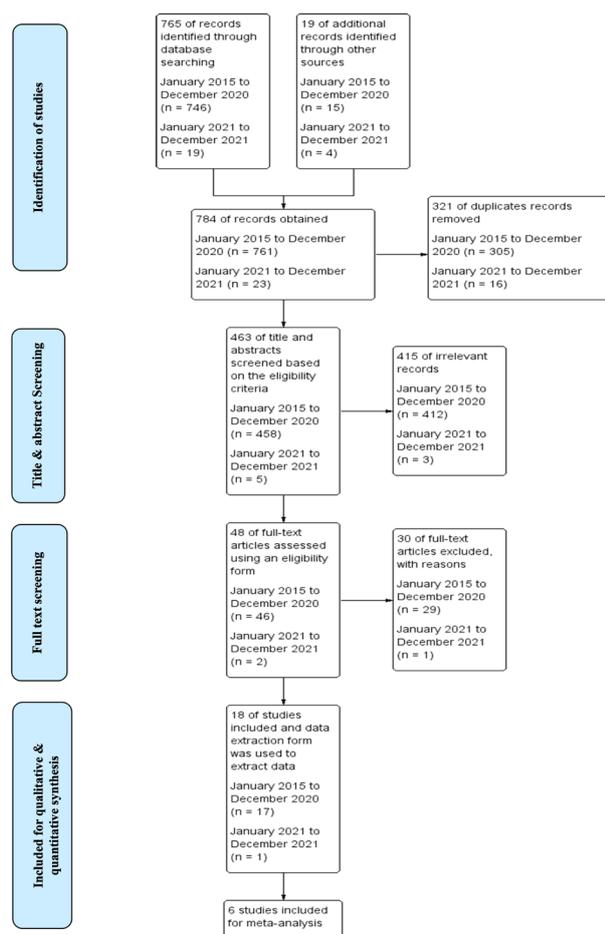


Figure 1: PRISMA flow diagram of studies selection

orthodontics patients (n = 1), and very young children (less than three years old) (n = 2), measuring non-clinical outcome only and using episode of pain to assess caries (n = 8). Seven studies were excluded because of multiple reasons. Only 18 studies met the eligibility criteria of this review.

Characteristics of included studies

The summary of the study characteristics is presented in Table I. Three studies were conducted in each China and India and one study each in Brazil, Belgium, Dominican Republic, Iran, Malaysia, Nepal, Romania, Sweden, Syria, Thailand, USA, and Uzbekistan respectively. Two studies were RCTs (16,17) and the others were cluster RCTs. All studies were conducted in a school setting (n = 12), had included preschool (n = 6), primary school (n = 5), and high school children (n = 7) aged three to 18 years and lasted between two to 48 months. Dentists were involved in most of the studies to deliver the intervention and assess the clinical outcomes.

Educational activities

The educational activities varied between the studies, and they were grouped into 14 categories: demonstration (number of studies with significant clinical findings/ number of studies: (10/12), distribution of printed materials (7/8), provision of oral health kit (6/8), fluoride

application (4/7), lecture with audio-visuals aids (6/6), conventional lecture (4/6), information technology-based (3/4), exhibition (3/4), games (3/3), toothbrushing drill (2/3), discussion (1/2), counselling (1/2), workshop (1/1), and audio materials (1/1) (see Table II). The demonstration was the most common activity and used in twelve studies compared to other activities which had been used in less than 50% of the included studies. Each activity has been significantly associated with at least one clinical or non-clinical outcome.

Topic of messages

The oral health topics covered in the studies ranged widely and had been categorised into 10 topics: oral health care (14/17), dietary (12/15), oral diseases (7/10), general oral health (7/8), fluoride (3/4), dental anatomy (2/4), oral health-related behaviour (1/3), parental roles in oral health care (1/3), dental treatment (1/2), and psychological (1/1) (see details in Supplemental file I). The former three topics were more frequently included in the studies compared to the others which had been used in less than 50% of the studies. Each topic has been found associated with at least one clinical or non-clinical outcome.

Target groups

The study participants receiving the intervention were children only (10 /11), children and parents (3/5), children and teachers (1/1), and children with both parents and teachers (1/1).

Summary of educational activities, topics in children, and target groups in all studies

The number of educational activities included in a study ranged from two (n = 6 studies) (18-23) to six (n = 1 study) (13) and the number of topics ranged from two (n = 6) (13,15,16,20,21,24) to six (n = 1 study) (22). All studies assessed the effect of the intervention on the children (15-18,20,22-27) and four included the effect on parents and/or teachers (19,28-30). Table III summarises each study by the target participants, topics, and educational activities and can be used in identifying the strategies that have been used for a particular age group.

Association between the number of activities, topics, and target group, and significant improvement in clinical and non-clinical outcomes

Analysis showed no association between the number of activities and improvement in clinical and non-clinical outcomes. However, the number of topics was significantly associated with an improvement in clinical outcomes (p = 0.01), and targeting only children in a study was associated with an improvement in non-clinical outcomes (p = 0.002).

DISCUSSION

This study reviewed the educational strategies of the intervention package of 18 oral health education trials

Table 1: Characteristics of included studies

Author (year)	Country	Target group	Children's age (years)	Setting	Study's duration (months)	Educator
Petersen et al. (2015) (12)	Thailand	<ul style="list-style-type: none"> • Children • Parents • Teachers 	4 to 6	Preschool	24	<ul style="list-style-type: none"> • Dentist • Teachers
Hedman et al. (2015) (25)	Sweden	<ul style="list-style-type: none"> • Children 	12 to 16	School	24	<ul style="list-style-type: none"> • Dental hygienist • Teachers
Braun et al. (2016) (29)	USA	<ul style="list-style-type: none"> • Children • Parents 	3 to 5	Preschool	36	<ul style="list-style-type: none"> • Community health workers
Pakpour et al. (2016) (24)	Iran	<ul style="list-style-type: none"> • Children 	15	School	6	<ul style="list-style-type: none"> • Health personnel
Shekhawat et al. (2016) (21)	India	<ul style="list-style-type: none"> • Children • Parents 	10 to 12	School	6	<ul style="list-style-type: none"> • Dentist
Si et al. (2016) (30)	China	<ul style="list-style-type: none"> • Children • Parents 	3 to 4	Preschool	12	<ul style="list-style-type: none"> • Dentist • Teachers • Health personnel
Vangipuram et al. (2016) (23)	India	<ul style="list-style-type: none"> • Children 	12 to 15	School	6	<ul style="list-style-type: none"> • Dentist • Peer-led
Al Bardaweel and Dashash (2018) (18)	Syria	<ul style="list-style-type: none"> • Children 	10 to 11	School	3	<ul style="list-style-type: none"> • Dentist
Khudanov et al. (2018) (17)	Uzbekistan	<ul style="list-style-type: none"> • Children 	14 to 18	School	2	<ul style="list-style-type: none"> • Dentist
Lambert et al. (2018) (26)	Belgium	<ul style="list-style-type: none"> • Children 	8 to 11	School	48	<ul style="list-style-type: none"> • Dental assistant
Marchetti et al. (2018) (20)	Brazil	<ul style="list-style-type: none"> • Children 	14 to 19	School	6	<ul style="list-style-type: none"> • Dentist
Abreu et al. (2019) (16)	Dominican Republic	<ul style="list-style-type: none"> • Children 	6 to 7	School	12	<ul style="list-style-type: none"> • Dentist
Séatcu et al. (2019) (27)	Romania	<ul style="list-style-type: none"> • Children 	13 to 16	School	24	<ul style="list-style-type: none"> • Dental student
Samuel et al. (2019) (13)	India	<ul style="list-style-type: none"> • Children • Teachers 	3 to 5	Preschool	24	<ul style="list-style-type: none"> • Dentist
Wu et al. (2020) (15)	China	<ul style="list-style-type: none"> • Children 	6 to 8	School	36	<ul style="list-style-type: none"> • Dentist
Anwar et al. (2020) (28)	Malaysia	<ul style="list-style-type: none"> • Children • Parents 	5 to 6	Preschool	6	<ul style="list-style-type: none"> • Dental therapist • Teachers
Cui et al. (2020) (19)	China	<ul style="list-style-type: none"> • Children • Parents 	4 to 5	Preschool	12	<ul style="list-style-type: none"> • Dentist • Health personnel • Teachers
Subedi et al. (2021) (22)	Nepal	<ul style="list-style-type: none"> • Children 	12 to 15	School	12	<ul style="list-style-type: none"> • Dentist

on children with a specific focus on the educational activities and topics, and target participants. It found that the oral health-related activities and topics range widely and categorised them into 14 categories and ten topics, respectively.

This review preferred the term education activity by McKenzie et al. (6) over methods of intervention by Gilbert et al. (11) when referring to the types of activities or actions performed in an intervention. It adopted a few labels from McKenzie et al. (6) and Gilbert et al. (11) and the remaining were derived by the authors to better match the description of the activity. Oral health demonstration is the most frequent activity (n = 12) used for delivering oral health care messages and was found significantly associated with improvement in five, two, and five studies in pre- (12,13,28,29,30), primary (15,16), and high school (17,22,23,24,27) children, respectively. Although not less important, other activities are less frequently employed. While activities such as demonstration, distribution of printed materials, oral health kits and audio material, lectures, information technology-based, and exhibitions require

less supervision by the education provider, those such as workshops, counselling, discussion, toothbrushing drill, games and fluoride application also require intensive supervision and have a greater implication on the operational time and manpower.

The oral health-related topics are very relevant and cover the subject of preventive behaviours, oral health and diseases, risk factors, and treatment. It also ranges widely with oral hygiene instruction, diet behaviour, and oral disease being more frequently included in the studies for all age groups. The content of most topics can be modified to match the age of study participants. A complex approach such as using psychological strategies to plan health behaviour is targeted at high school children. Likely, the topics on anatomy, diet, fluoride use, and parental role are delivered to the parents and teachers with the belief that improving the participants' knowledge will help them motivate the children (13,19,28,29). Unfortunately, only one study included tobacco and alcohol-related topics for high school children (25); the topics are also beneficial for parents and younger children.

Table II: List of the activities and descriptions, and studies using the activities.

Activities (n)	Description	Studies
Demonstration (12)	A practical exhibition and explanation of oral health care demonstrating the correct method of toothbrushing, flossing, and plaque assessment techniques by demonstrators using visual aids such as teeth models, photos, or Q-scan devices.	SC: #1, #4, #6, #7, #10, #12, #13, #14, #15, #18 NSC: #3, #16
Distribution of printed materials (8)	Education materials in the form of pamphlets, leaflets, brochures, or booklets are provided to the study participants.	SC: #1, #4, #5, #8, #10, #13, #17 NSC: #2
Provision of oral health kit (8)	Toothbrushes and fluoridated toothpaste are given to the study's participants to motivate toothbrushing at school or at home.	SC: #1, #4, #10, #13, #14, #15 NSC: #3, #16
Fluoride application (7)	Application of topical fluoride by dental personnel.	SC: #6, #14, #15, #17 NSC: #2, #3, #16
Lecture with audio-visuals aids (AV) (6)	A talk by dental personnel in a face-to-face setting with the aid of any form of media such as PowerPoint Presentation (PPT) or videos.	SC: #6, #7, #9, #13, #17, #18
Conventional lecture (6)	A talk by dental personnel in a face-to-face setting without additional aid.	SC: #1, #10, #11, #14 NSC: #3, #16
Information technology-based (4)	Delivery of educational messages via the internet involves the use of electronic devices (computers, smartphones) and online platforms (websites, phone apps).	SC: #8, #9, #11 NSC: #16
Exhibition (4)	A display of posters, photos, and props such as dental models and cigarettes with relevant educational messages at strategic places.	SC: #1, #5, #13 NSC: #2
Games (3)	Delivery of educational messages in the form of fun and playful activities such as puzzles, quizzes, or flashcards.	SC: #5, #11, #12
Toothbrushing drill (3)	Toothbrushing at school under the supervision of dental personnel or teachers.	SC: #1, #13 NSC: #16
Discussion (2)	A discussion and brainstorming of educational messages in a small group with or without game activity.	SC: #12 NSC: #2
Counselling (2)	Provision of professional assistance, advice, and guidance on oral health care in a one-to-one setting between parents/children and dental personnel.	SC: #15 NSC: #16
Workshop (1)	Delivery of educational message through discussion and practical work to develop practical skills.	SC: #1
Audio materials (1)	Delivery of educational messages through music; messages are embedded in the lyric of a song and passed to the children (e.g.: on a CD).	SC: #1

n: number of studies that had included the activity, SC: studies with significant clinical findings, NSC: studies with no significant clinical finding, # refer to study ID

In all studies, children are the main focus of the intervention and their oral health status is the main outcome. Thus far, the benefits of including parents and teachers in an intervention program for children are still not clear. In this study, the analysis showed that intervention on children only is associated with an improvement in non-clinical outcomes but not clinical outcomes. An earlier review reported that school intervention, including those involving teachers, has no long-term effect on clinical outcomes (7). In contrast, another review claimed that a comprehensive intervention involving parents, teachers, and children can improve the clinical oral status and behaviour of children (8). Hence, more evidence is needed to better understand the overall effect of including parents and teachers in an intervention program including the cost, manpower, training time, and the additional burden on them.

The current review found that all studies employed a mix of educational strategies; more than one activity and topic are combined in a package and delivered to one or more target participant categories. Because of the lack of details in the reports, it is unclear whether a topic is delivered using more than one activity and whether one activity is used to deliver more than one topic. Studies addressing these issues can be carried out, for example, by comparing the effectiveness of oral hygiene instruction delivered using different activities such as a live demonstration, video, and a lecture with and without

audio-visual aid. Studies of similar contexts addressing other activities and topics should be encouraged.

The mixed strategies also raise the question of, which activity, topic, or their combinations and, whether a greater number of strategies, is more effective for improving the study outcome. Multiple strategies are thought to appeal to a variety of learning styles and senses while hoping that one of them will influence the target population (6,32) but there is currently neither empirical evidence nor a recommendation specifying the number of activities or topics in an intervention. Similarly, there are theoretical discussions and recommendations on the appropriate content, depth, and strategies for delivering oral health messages for children of different ages, but without supporting empirical evidence (6,11,33). Based on the small number of studies, the current analysis found that including two to three topics in an intervention may be sufficient for improving clinical outcomes ($p < 0.05$) and, no evidence for or against including fewer or more activities in an intervention program.

An oral health intervention program is normally designed, planned, and implemented to meet the need of a specific target population. Thus, to imitate an earlier design, a new program has to match the oral health problem and background of the new target population to the earlier study. This review found only five reports mentioning the oral health problems of the respective target population (12,13,22,28,29).

Table III: Summary of educational activities, topics in children, and target groups in all studies (n = 18)

Author (year)	Target Group	Topics	Activities	Outcomes
Petersen et al. (2015) (12)	<ul style="list-style-type: none"> • Preschool children and parents • Teachers • Preschool children • Parents 	<ul style="list-style-type: none"> • Oral disease • Dietary • Oral health care • General oral health • Similar to the conventional lecture • Oral health care • Oral health care • Dietary 	<ul style="list-style-type: none"> • Conventional lecture • Workshops • Audio • Demonstration • Toothbrushing drill • Provision of oral health kit • Exhibition • Distribution of printed materials (brochures) 	<ul style="list-style-type: none"> • Caries* • Plaque*
Hedman et al. (2015) (25)	<ul style="list-style-type: none"> • High school children 	<ul style="list-style-type: none"> • Dietary • Oral health care • Oral health behaviour • Dietary • Oral diseases and dietary 	<ul style="list-style-type: none"> • Discussion • Distribution of printed material (booklets) • Exhibition • Fluoride application 	<ul style="list-style-type: none"> • Caries • Knowledge*
Braun et al. (2016) (29)	<ul style="list-style-type: none"> • Preschool children • Parents 	<ul style="list-style-type: none"> • Teeth anatomy • Oral health care • Dietary • Fluoride • General oral health • Oral health care • Oral diseases • Parent's roles 	<ul style="list-style-type: none"> • Conventional lecture • Demonstration • Fluoride application • Provision of oral health kit • Conventional lecture 	<ul style="list-style-type: none"> • Caries • Parent's knowledge of a child's oral health
Pakpour et al. (2016) (24)	<ul style="list-style-type: none"> • High school children 	<ul style="list-style-type: none"> • Oral health care • Psychological (planning of brushing behaviour) 	<ul style="list-style-type: none"> • Distribution of printed material (leaflets) • Demonstration • Provision of oral health kit 	<ul style="list-style-type: none"> • OH behaviour* • Plaque* • Periodontal status* • Psychological outcomes*
Shekhawat et al. (2016) (21)	<ul style="list-style-type: none"> • Primary school children • Parents 	<ul style="list-style-type: none"> • General oral health • Oral health care • General oral health 	<ul style="list-style-type: none"> • Games • Exhibition • Distribution of printed materials (booklets) 	<ul style="list-style-type: none"> • Plaque* • Gingivitis*
Si et al. (2016) (30)	<ul style="list-style-type: none"> • Preschool children and parents 	<ul style="list-style-type: none"> • General oral health • Dietary • Oral health care 	<ul style="list-style-type: none"> • Lecture with AV aids • Demonstration • Fluoride application 	<ul style="list-style-type: none"> • Caries* • Parent's knowledge of child oral health*
Vangipuram et al. (2016) (23)	<ul style="list-style-type: none"> • High school children 	<ul style="list-style-type: none"> • Dietary • Oral diseases • Oral health care 	<ul style="list-style-type: none"> • Lecture with AV aids • Demonstration 	<ul style="list-style-type: none"> • Plaque* • Gingivitis* • Knowledge* • Attitude* • Practice*
Al Bardaweel and Dashash (2018) (18)	<ul style="list-style-type: none"> • Primary school children 	<ul style="list-style-type: none"> • Oral health care • Dietary • Fluoride • Same content as printed material 	<ul style="list-style-type: none"> • Distribution of printed material (leaflets) • Information technology-based 	<ul style="list-style-type: none"> • Plaque* • Gingivitis* • Knowledge*
Khudanov et al. (2018) (17)	<ul style="list-style-type: none"> • High school children 	<ul style="list-style-type: none"> • General oral health • Oral diseases • Oral health care • Dietary • Fluoride • Same content as conventional lecture • Oral health care 	<ul style="list-style-type: none"> • Conventional lecture • Distribution of printed material (leaflets) • Demonstration • Provision of oral health kit 	<ul style="list-style-type: none"> • Plaque* • Knowledge* • Attitude • Behaviour*
Lambert et al. (2019) (26)	<ul style="list-style-type: none"> • Primary school children 	<ul style="list-style-type: none"> • Oral health care • Dietary • General oral health • Same as in a conventional lecture 	<ul style="list-style-type: none"> • Conventional lecture • Games • Information technology-based 	<ul style="list-style-type: none"> • Caries • Plaque* • Knowledge*
Marchetti et al. (2018) (20)	<ul style="list-style-type: none"> • High school children 	<ul style="list-style-type: none"> • General oral health • Oral diseases • Same contents as a lecture with AV 	<ul style="list-style-type: none"> • Lecture with AV aids • Information technology-based 	<ul style="list-style-type: none"> • Plaque* • Gingivitis* • Knowledge*
Abreu et al. (2019) (16)	<ul style="list-style-type: none"> • Primary school children 	<ul style="list-style-type: none"> • Oral health care • Dietary • Oral health care 	<ul style="list-style-type: none"> • Counselling (small group) • Demonstration • Fluoride application • Provision of oral health kit 	<ul style="list-style-type: none"> • Caries*
Sieatcu et al. (2019) (27)	<ul style="list-style-type: none"> • High school children 	<ul style="list-style-type: none"> • Oral diseases • Dietary • Oral health behaviour • Oral diseases • Oral health care 	<ul style="list-style-type: none"> • Discussion • Games • Demonstration 	<ul style="list-style-type: none"> • Caries* • Plaque* • Gingivitis* • Behaviour* • Knowledge*
Samuel et al. (2019) (13)	<ul style="list-style-type: none"> • Preschool children and teachers • Preschool children 	<ul style="list-style-type: none"> • Oral health care • Dietary • Oral health care • Oral health care • Dietary • Oral health care 	<ul style="list-style-type: none"> • Lecture with AV aids • Demonstration • Distribution of printed materials (pamphlet) • Exhibition • Toothbrushing drill • Provision of oral health kit 	<ul style="list-style-type: none"> • Caries* • Plaque* • Gingivitis*
Wu et al. (2020) (15)	<ul style="list-style-type: none"> • Primary school children 	<ul style="list-style-type: none"> • Oral health care • Dietary • Same as in a conventional lecture 	<ul style="list-style-type: none"> • Conventional lecture • Demonstration • Fluoride application • Provision of oral health kit 	<ul style="list-style-type: none"> • Caries*
Anwar et al. (2020) (28)	<ul style="list-style-type: none"> • Preschool children • Preschool children • Parents 	<ul style="list-style-type: none"> • Teeth anatomy • Oral health care • Oral diseases • Dietary • Oral health care • Dietary • Teeth anatomy • Parent's roles • Oral diseases • Oral health care • Oral health behaviour • Dental treatment 	<ul style="list-style-type: none"> • Conventional lecture • Demonstration • Fluoride application • Toothbrushing drill • Provision of oral health kit • Counselling • Information technology-based 	<ul style="list-style-type: none"> • Plaque • Parent's OH literacy*

Table III: Summary of educational activities, topics in children, and target groups in all studies (n = 18) (Continued)

Author (year)	Target Group	Topics	Activities	Outcomes
Cui et al. (2020) (19)	<ul style="list-style-type: none"> • Preschool children and parents • Preschool children • Parents 	<ul style="list-style-type: none"> • General oral health • Oral health care • Dietary • Oral diseases • Teeth anatomy • Parent's role • General oral health 	<ul style="list-style-type: none"> • Lecture with AV aids • Fluoride application • Distribution of printed materials (brochures) 	<ul style="list-style-type: none"> • Caries* • Plaque* • Parent's knowledge of a child's oral health
Subedi et al. (2021) (22)	<ul style="list-style-type: none"> • High school children 	<ul style="list-style-type: none"> • Teeth anatomy • Oral health care • Oral diseases • Dental treatment • Dietary • Fluoride 	<ul style="list-style-type: none"> • Lecture with AV aids • Demonstration 	<ul style="list-style-type: none"> • Caries • Plaque* • Gingivitis* • Knowledge* • Attitude* • Practice*

* Significant outcomes (p < 0.05)

APF: Acidulated phosphate fluoride, AV: Audio-visual, CRA: Caries risk assessment, FA: Fluoride application, OHE: Oral health education, STB: Supervised toothbrushing

The success of an intervention should not be based on only clinical and non-clinical outcomes; the overall cost-efficiency and feasibility must also be considered. Adding more activities, topics, and intervention groups will increase the cost, logistics, manpower, and time involved in designing, planning, and implementing the program but there is limited understanding and evidence on these. None of the issues mentioned has been reported in the included studies. The insignificant clinical effect, small effect sizes, and unknown cost-effectiveness may explain the lack of translation of the packaged programs from earlier studies to a mass intervention for the reference population.

All included reports have provided adequate information for this review and somewhat represent the research carried out in the lower- and high-income countries. This review included only studies with a control group receiving either no intervention or standard care only to homogenise the comparison group and minimise bias from the relative effect of the active intervention (31). The primary goal of the studies is to assess whether the designed program can prevent oral diseases effectively in children. Hence, this review considered the clinical outcome as an important criterion because an intervention failing to show an improvement in clinical outcomes is not cost-effective, despite the significant improvement in non-clinical outcomes in the children, parents, or teachers. These are the guiding principles of this review leading to the revision of the eligibility criteria for including only studies with clinical outcomes. The current review is the first to assess the intervention strategies used in oral health education trials. The summary in Table III can be used as a quick reference for researchers and oral health professionals when designing an intervention.

The findings of this review are limited by the small number of studies included. Studies before the year 2015 were excluded because a systematic review (7) showed no improvement in clinical outcomes in studies published between the years 1995 to 2015. The quality of evidence of the included studies was not rigorously assessed such as that in a systematic review and may affect the statistical findings if more studies

are excluded. Although the result and appraisal of the synthesised data are less affected by the issue, the findings and recommendations from this review should be interpreted with caution.

CONCLUSION

The design of previous oral health education programs is based on mixed strategies that include multiple activities, oral health-related topics, and target participants; it remains unclear if one program, activity, topic, or combination of them has an advantage over another in preventing oral diseases in children. Investigators and oral health professionals should carefully consider the number of activities, topics, and target participants when designing a balanced, optimum, and cost-effective intervention program. As the cost-effectiveness of a program is influenced by educational strategies employed, it should also be considered as an outcome and the method for assessing it should be explored.

ACKNOWLEDGEMENT

The authors thank the librarians at the Hamdan Tahir Library, Universiti Sains Malaysia for assisting and validating the literature search strategy.

REFERENCES

1. FDI World Dental Federation. The Challenge of Oral Disease - A call for Global Action. The Oral Health Atlas. 2nd ed. Geneva: FDI World Dental Federation; 2015.
2. Kassebaum NJ, Bernabe E, Dahiya M, Bhandari B, Murray CJL, Marcenes W. Global burden of untreated caries: A systematic review and metaregression. *Journal of Dental Research*. 2015;94(5):650–658. doi: 10.1177/0022034515573272
3. Abanto J, Tsakos G, Paiva SM, Carvalho TS, Raggio DP, Bonecker M. Impact of dental caries and trauma on quality of life among 5 to 6-year-old children: Perceptions of parents and children. *Community Dentistry and Oral Epidemiology*. 2014;42(5):385–394. doi: 10.1111/cdoe.12099.
4. Pakkhesal M, Riyahi E, Naghavi Alhosseini AA, Amdjadi P, Behnampour N. Impact of dental

- caries on oral health-related quality of life among preschool children: perceptions of parents. *BMC Oral Health*. 2021;21(1): 1–8. doi: 10.1186/s12903-021-01396-4.
5. Joint Committee on Terminology. Report of the 2011 Joint Committee on Health Education and Promotion Terminology. *American Journal of Health Education*. 2012;43(2).
 6. McKenzie J, Neiger B, Thackeray R. Planning, implementing, & evaluating health promotion programs: A Primer. 6th ed. San Francisco, USA: Pearson Benjamin Cummings; 2012.
 7. Stein C, Santos NML, Hilgert JB, Hugo FN. Effectiveness of oral health education on oral hygiene and dental caries in schoolchildren: Systematic review and meta-analysis. *Community Dentistry and Oral Epidemiology*. 2018;46(1):30–37. doi: 10.1111/cdoe.12325.
 8. Bramantoro T, Santoso CMA, Hariyani N, Setyowati D, Zulfiana AA, Mohd Nor NA, et al. Effectiveness of the school-based oral health promotion programmes from preschool to high school: A systematic review. *PLoS ONE*. 2021;16(8):1–16. doi: 10.1371/journal.pone.0256007.
 9. Arksey H, O'Malley L. Scoping studies: Towards a methodological framework. *International Journal of Social Research Methodology: Theory and Practice*. 2005;8(1):19–32. doi: 10.1080/1364557032000119616
 10. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA extension for scoping reviews (PRISMA-ScR): Checklist and explanation. *Annals of Internal Medicine*. 2018;169(7):467–473. doi: 10.7326/M18-0850.
 11. Gilbert GG, Sawyer RG, McNeil EB. Health education creating strategies for school and community health. 3rd ed. Sudbury, Massachusetts: Jones and Bartlett Publishers; 2011.
 12. Petersen PE, Hunsrisakhun J, Thearmontree A, et al. School-based intervention for improving the oral health of children in Southern Thailand. *Community Dental Health*. 2015;32(1):44–50.
 13. Samuel SR, Acharya S, Rao JC. School Interventions-based Prevention of Early-Childhood Caries among 3–5-year-old children from very low socioeconomic status: Two-year randomized trial. *Journal of Public Health Dentistry*. 2020;80(1):51–60. doi: 10.1111/jphd.12348
 14. Pine C, Harris R. *Community Oral Health*. 2nd ed. New Malden, United Kingdom: Quintessence Publishing Co Ltd; 2007.
 15. Wu S, Zhang T, Liu Q, Yu X, Zeng X. Effectiveness of fluoride varnish on caries in the first molars of primary schoolchildren: a 3-year longitudinal study in Guangxi Province, China. *International Dental Journal*. 2020;70(2):108–115. doi: 10.1111/idj.12528
 16. Abreu-Placeres N, Garrido LE, Jaquez IC, Feliz-Matos LE. Does applying fluoride varnish every three months better prevent caries lesions in erupting first permanent molars? A randomised clinical trial. *Oral Health and Preventive Dentistry*. 2019;17(6):541–546. doi: 10.3290/j.ohpd.a43566.
 17. Khudanov B, Jung HI, Kahharova D, et al. Effect of an oral health education program based on the use of quantitative light-induced fluorescence technology in Uzbekistan adolescents. *Photodiagnosis and Photodynamic Therapy*. 2018;21(January): 379–384. doi: 10.1016/j.pdpdt.2018.01.012.
 18. Al Bardaweel S, Dashash M. E-learning or educational leaflet: does it make a difference in oral health promotion? A clustered randomized trial. *BMC Oral Health*. 2018;18(1 CC-Oral Health):81. doi: 10.1186/s12903-018-0540-4
 19. Cui T, Xu Q, Wu Y, Yang X, Li T, Sun H. Longitudinal follow-up survey of effects of oral comprehensive healthcare measures on early childhood caries. *Oral Health and Preventive Dentistry*. 2020;18(2):197–203. doi: 10.3290/j.ohpd.a43347.
 20. Marchetti G, Fraiz FC, Nascimento WMD, Soares GMS, Assuncao L. Improving adolescents' periodontal health: evaluation of a mobile oral health App associated with conventional educational methods: a cluster randomized trial. *International Journal of Paediatric Dentistry*. 2018;28(4 CC-Oral Health):410–419. doi: 10.1111/ipd.12371.
 21. Shekhawat KS, Chauhan A, Sakthi Devi S, Kumar H, Mishra P. School based intervention programme on gingival health of 10-12 years Old Government Aided School Children of Basavangudi in Bangalore City – A randomized controlled trial. *Indian Journal of Public Health Research and Development*. 2016;7(2):74–80. doi: 10.5958/0976-5506.2016.00070.X
 22. Subedi K, Shrestha A, Bhagat T, Baral D. Effectiveness of oral health education intervention among 12–15-year-old school children in Dharan, Nepal: a randomized controlled trial. *BMC Oral Health*. 2021;21(1):1–11.
 23. Vangipuram S, Jha A, Raju R, Bashyam M. Effectiveness of peer group and conventional method (Dentist) of oral health education programme among 12–15-year-old school children - A randomized controlled trial. *Journal of Clinical and Diagnostic Research*. 2016;10(5): ZC125–ZC129. doi: 10.7860/JCDR/2016/17725.7844
 24. Pakpour AH, Yekaninejad MS, Sniehotta FF, Updegraff JA, Dombrowski SU. The effectiveness of gain-versus loss-framed health messages in improving oral health in Iranian secondary schools: A cluster-randomized controlled trial. *Annals of Behavioral Medicine*. 2014;47(3):376–387. doi: 10.1007/s12160-013-9543-1.
 25. Hedman E, Gabre P, Birkhead D. Dental hygienists working in schools - a two-year oral health intervention programme in Swedish secondary

- schools. *Oral Health & Preventive Dentistry*. 2015;13(2):177–188. doi: 10.3290/j.ohpd.a32132.
26. Lambert MJ, De Visschere LMJ, Martens LC, Deschepper E, Vanobbergen J. The impact of a prospective 4-year longitudinal school intervention for improving oral health and oral health inequalities in primary schoolchildren in Flanders-Belgium. *International Journal of Paediatric Dentistry*. 2019;29(4):439–447. doi: 10.1111/ipd.12477.
 27. Sfeatcu R, Dumitrache MA, Caramida M, Johannsen A, Perlea P. A pilot study on the effectiveness of a 2-year school-based oral health educational programme using experiential learning among adolescents. *International Journal of Dental Hygiene*. 2019;17(3):221–228. doi: 10.1111/idh.12400
 28. Anwar NH, Mohd Nor NA, Mohd Yusof ZY. Effect of the SIMS program on oral hygiene levels of 5–6-year-old children in the Kampar District, Malaysia: A cluster-randomized controlled trial. *Makara Journal of Health Research*. 2020;24(2):128–139. doi: 10.7454/msk.v24i2.1209
 29. Braun PA, Quissell DO, Henderson WG, Bryant LL, Gregorich SE, George C, et al. A Cluster-Randomized, Community-Based, Tribally Delivered Oral Health Promotion Trial in Navajo Head Start Children. *Journal of Dental Research*. 2016;95(11 CC-Oral Health):1237-1244. doi: 10.1177/0022034516658612
 30. Si Y, Guo Y, Yuan C, Xu T, Zheng SG. Comprehensive Oral Health Care to Reduce the Incidence of Severe Early Childhood Caries (s-ECC) in Urban China. *The Chinese Journal of Dental Research: The Official Journal of the Scientific Section of the Chinese Stomatological Association (CSA)*. 2016;19(1):55–63. doi: 10.3290/j.cjdr.a35698
 31. Karlsson P, Bergmark A. Compared with what? An analysis of control-group types in Cochrane and Campbell reviews of psychosocial treatment efficacy with substance use disorders. *Addiction*. 2015;110(3):420–428. doi: 10.1111/add.12799.
 32. Kline MV, Huff RM. Tips for the practitioner. In: Huff RM, Kline MV, ed. *Promoting health in multicultural populations*. Thousand Oaks, California: SAGE Publications; 1999; 103–111.
 33. Goswami, U. *Children’s Cognitive Development and Learning (CPRT Research Survey 3)*. New York: Cambridge Primary Review Trust; 2015.