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THE IMPACT OF SCHOOL-BASED ORAL HEALTH EDUCATION PROGRAMS ON CHILDREN'S ORAL HYGIENE: SYSTEMATIC REVIEW

SAFA ESSA ALYAKUB
Dental Assistant, Dentistry and Related Specialties, Ibn Hayyan Primary Health Care, Alkhobar, Saudi Arabia.

AMAL SAUD ALOUDAH
Dental Assistant, Dentistry and Related Specialties, Ibn Hayyan Primary Health Care, Alkhobar, Saudi Arabia.

AMANI JAFER ALHEJJI
Dental Assistant, Dentistry and Related Specialties, Ibn Hayyan Primary Health Care, Alkhobar, Saudi Arabia.

ROQAIAH AOUN ALRAMDAN
Dental Assistant, Dentistry and Related Specialties, Ibn Hayyan Primary Health Care, Alkhobar, Saudi Arabia.

FATIM ABDULMAJEED ALMASKEEN
Dental Hygienist, Dentistry and Related Specialties, Ibn Hayyan Primary Health Care, Alkhobar.

ZAINAB AHMAD ALNASSER
Dental Hygienist, Dentistry and Related Specialties, Al-Danah Primary Health Care, Alkhobar.

ROUMYAH IBRAHIM AL SHABEEB
Dental Hygienist, Dentistry and Related Specialties, Al Aqrabiyah Primary Health Care, Alkhobar.

EBTEHAJ HASSAN ALZAYED
Dental Hygienist, Dentistry and Related Specialties, Khuzama Primary Health Care, Alkhobar.

Abstract

Background: Poor oral hygiene is a prevalent public health concern in children, leading to dental caries and gingivitis which can be prevented. Schools are recognized as strategic settings for delivering oral health education (OHE), which provide continuous access to children during their formative years.In this systematic review we aimed to evaluate the effectiveness of school-based oral health education programs in improving children's oral hygiene, knowledge, and related behaviors. **Methods:** A systematic search was conducted in PubMed, Scopus, Web of Science, and Google Scholar to identify original peer-reviewed studies to assess school-based OHE interventions for children aged 18 years or younger. We include studies measured at least one oral health outcome (plaque index, brushing frequency, caries incidence). Risk of bias was assessed using the Cochrane RoB 2 tool for randomized trials and ROBINS-I for non-randomized studies. A qualitative synthesis approach was used. **Results:** Ten studies (8 RCTs and 2 quasi-experimental) with a total sample of 5,539 children were included. Interventions differ in duration, educator type (peer, teacher, dental professional), and theoretical framework. Most studies show significant improvements in oral hygiene behaviors, plaque levels, and knowledge post-intervention. Peer-led approaches and programs which incorporate behavioral theories showed greater effectiveness in behavior change. Reinforcement and educator involvement were key factors contributing to sustained outcomes. **Conclusion:** School-based oral health education programs are effective to enhance children's oral hygiene knowledge and practices. Programs involving interactive methods, behaviors, and consistent

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reinforcement are more likely to produce lasting improvements. Integration of these programs into school curricula is recommended to promote long-term oral health in children.

Keywords: Oral Hygiene; Children; School-Based Intervention; Oral Health Education; Peer-Led Programs; Dental Caries Prevention; Health Promotion; Systematic Review.

INTRODUCTION

Oral health is importantfor children well-being, with a direct effect on their growth, learning, nutrition, and psychosocial development. Dental diseases isone of the most common chronic conditions affecting children globally (1). These conditions, including dental caries and gingivitis, are preventable, but their prevalence continues to rise, mainlyin socioeconomically disadvantaged populations. The consequences of poor oral health in children extend beyond the mouth, often resulting in pain, sleep disturbances, missed school days, and reduced quality of life (1).

Schools have been recognized as effective place for promoting oral health due to their structured environment, wide reach, and ability to provide repetitive, age-appropriate educational interventions. A literature review by Corrêa et al. (2)show that oral health education targeting both children and the adults involved in their careimprove oral hygiene outcomes. Their findings indicated that educational strategies of families and educators lead to reductions in the prevalence of dental caries and periodontal conditions. Socioeconomic factors, parental education and employment status, play a major role in children's oral health. Minervini et al. conducted a cross-sectional study and found a significant association between low parental education, unemployment, and poorer oral health outcomes in children, as measured by the Early Childhood Oral Health Impact Scale (ECOHIS)(3).These studies indicate that school-based oral health education programs mainly those involve educators and address the socioeconomic context of students, can be a powerful tool to improve children's oral hygiene. Our systematic review aims to evaluate the impact of these programs on children's oral hygiene practices and outcomes, and we focused on intervention structure, behavioral effects, and contextual factors that affect the outcomes.

METHODOLOGY

This systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. We aimed to evaluate the impact of school-based oral health education (OHE) programs on children’s oral hygiene. We include studies involved children or adolescents aged 18 years or younger and assessed a school-based OHE intervention delivered by peers, teachers, or dental professionals. Eligible studies reported at least one measurable oral health outcome (plaque index, toothbrushing or flossing frequency, caries incidence, gingival health, or oral health-related knowledge, attitude, and behavior). Only original peer-reviewed articles published in English were included. We exclude review articles, conference abstracts, protocols, editorials, and studies not involving a school setting or not report relevant outcomes (Fig 1). A literature search was conducted in four electronic databases (PubMed, Scopus, Web of Science, and Google Scholar). The search

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strategy include keywords and MeSH terms (oral health education, school-based, children, students, oral hygiene, and intervention). The search was supplemented by a manual review of the reference lists of included articles to identify additional studies not captured in the database search. All identified articles were imported into a citation management software and duplicates removed. Two independent reviewers screened titles and abstracts based on the predefined eligibility criteria. Full-text articles of eligible studies were retrieved and reviewed for inclusion. Disagreements between reviewers were resolved through discussion. Data extraction was performed using a standardized form, which captured information on study title, authors, publication year, country, study design, aim, sample size, demographic characteristics, intervention type and duration, comparator group, primary outcomes and findings.

The risk of bias for each included study was assessed using tools appropriate to the design. The Cochrane Risk of Bias 2 (RoB 2) tool was usedfor randomized controlled trials and cluster RCTs (Table 1)evaluating five domains: bias arising from the randomization process, deviations from intended interventions, missing outcome data, measurement of outcomes, and selection of the reported result. The Risk Of Bias In Non-randomized Studies - of Interventions (ROBINS-I) tool was used for quasi-experimental and non-randomized controlled studies. This tool assesses potential bias due to confounding, participant selection, classification of interventions, deviations from intended interventions, missing data, measurement of outcomes, and selective reporting (Table 2). Aqualitative data synthesis approach was utilized. Studies were grouped and compared based on the type of intervention and the primary outcomes assessed. The effectiveness of different educator models (peer-led, teacher-led, and professional-led) was examined, as well as the effect of theoretical the Health Belief Model, Social Cognitive Theory, and Bandura's self-efficacy theory on intervention outcomes.

Table 1: Cochrane RoB 2 assessment for included RCTs

Study	Randomization Process	Deviations from Intended Interventions	Missing Outcome Data	Measurement of Outcome	Selection of Reported Results	Overall Risk of Bias
Xiang et al., 2021	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Ghasemi et al., 2025	Low risk	Some concern	Low risk	Low risk	Low risk	Some concerns
Haleem et al., 2012	Some concerns	Low risk	Low risk	Low risk	Low risk	Some concerns
Haleem et al., 2016	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Vangipuram et al., 2016	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Hosseini et al., 2025	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Taheri et al., 2025	Low risk	Some concerns	Low risk	Low risk	Low risk	Some concerns

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Table 2: ROBINS-I assessment for Non-Randomized studies

Study	Bias due to confounding	Bias in selection of participants	Bias in classification of interventions	Bias due to deviations from intended interventions	Bias due to missing data	Bias in measurement of outcomes	Bias in selection of reported result	Overall risk of bias
Karimy et al., 2020	Moderate	Low	Low	Low	Low	Low	Moderate	Moderate
Karami et al., 2019	Serious	Moderate	Low	Low	Low	Moderate	Moderate	Serious
Aleksejuniene et al., 2022	Moderate	Low	Low	Low	Low	Low	Low	Moderate

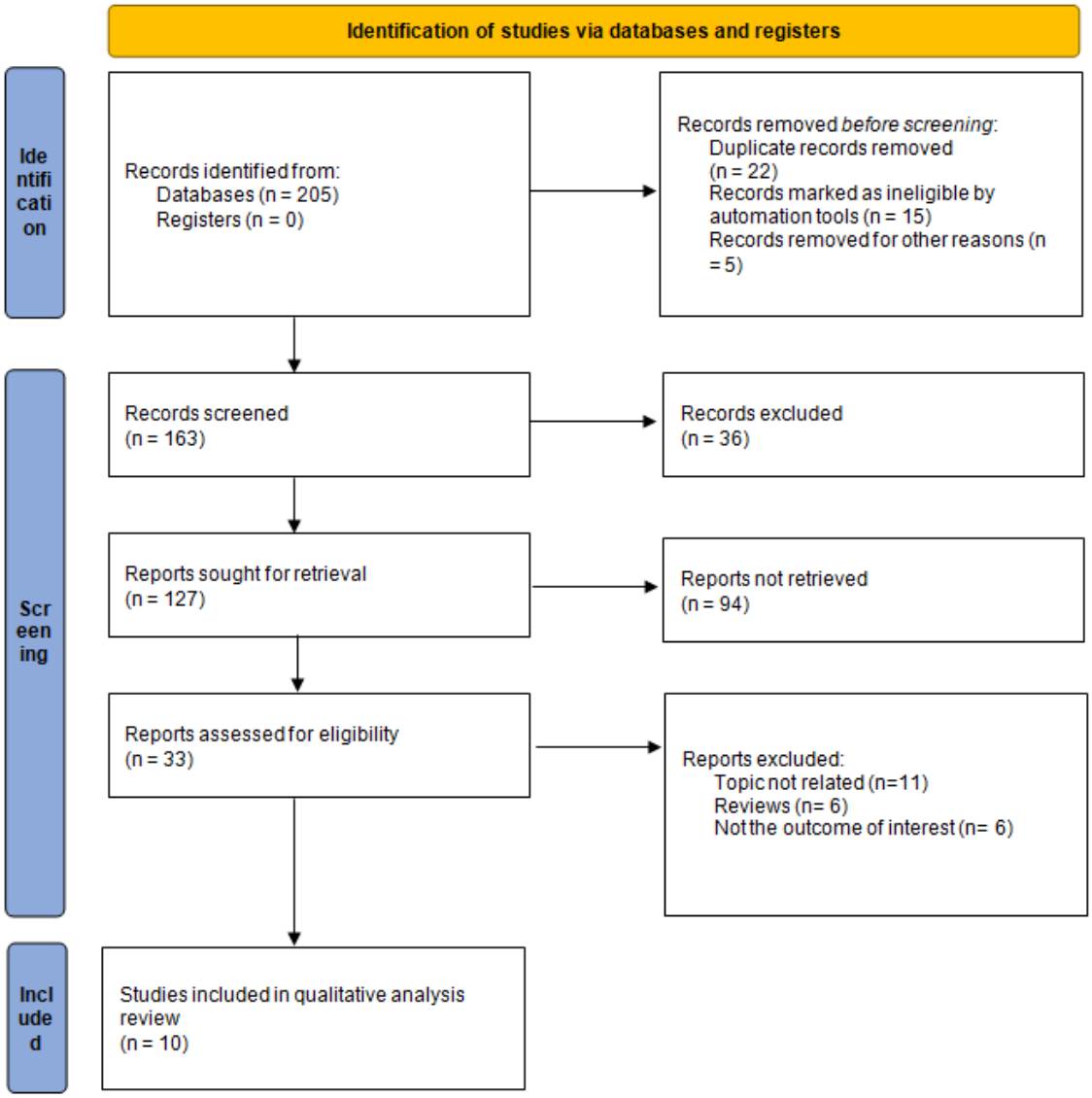

Fig 1: PRISMA consort chart of study selection

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RESULT

Characteristics of the included studies

A total of ten studies were included in our systematic review, consist of eight randomized controlled trials (RCTs) and two quasi-experimental studies (Table 3). These studies assessed the effectiveness of school-based oral health education (OHE) programs indifferent populations and geographic regions, including Hong Kong, Iraq, Pakistan, Iran, India, and Canada. The total sample size was 5,539 children, ranging from 80 to 1,184 participants.Most interventions (n = 8) were structured educational programs delivered by peers, teachers, or oral health professionals. Two studies utilizedHealth Belief Model, Social Cognitive Theory, and Bandura's self-efficacy model. Intervention durations varied from single sessions to repeated sessions delivered over several months.

Oral health knowledge and behaviors

The included studies reported significant improvements in oral health-related knowledge and behaviors in children who received OHE interventions compared to control groups. One study show that a peer-led intervention using theoretical models resulted in improved brushing and flossing frequencies, oral health-related quality of life (OHRQoL), and reductions in plaque and dental caries after 12 months (4). Haleem et al., (2012) (5)study reported that dentist-, teacher-, and peer-led interventions were all effective in improving oral health knowledge and hygiene, with peer-led education being more effective in changing behavior.Improvements in behavior-related constructs (planning and coping mechanisms)were also noted. Significant gains in behavioral intentions and self-regulation regarding tooth brushing and flossing were observed in an intervention that applied the Theory of Planned Behavior in a peer-led format (6). Another RCT found that students receiving fluoride varnish in addition to education lower caries incidence than those who received education alone (7).

Clinical oral health outcomes

Six of the included studies measured clinical outcomes (plaque levels, gingival status, and caries indices). A trial comparing dentist- and peer-led models showed a reductions in plaque and gingival scores at 3- and 6-month follow-ups in both groups (8). In a non-randomized controlled trial, the peer-led group show superior improvements in oral self-care practices and skills compared to the standard classroom approach (9). Another study of self-efficacy principles and parental engagement reported significantly improved oral hygiene practices and reduced plaque accumulation (10).

Role of reinforcement and literacy

Long-term effectiveness of OHE was supported in Haleem et al., (2016) (11)study that incorporated repetition and reinforcement, which showed sustained improvements in knowledge, behavior, and hygiene outcomes up to 12 months post-intervention. Interventions focused on enhancing oral health literacy in multiple domains (cognitive, behavioral, and media literacy) also show significant positive outcomes (10,12).

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Comparison of educator models

Two studies compared the relative effectiveness of educator types. Dentist- and teacher-led models were effective, and peer-led approaches achieved better results in regarding behavioral outcomes, feasibility, and cost-effectiveness (8,13).

Table 3: Summary table of included studies

Citation	Study Design	Study Aim	Sample Size	Demographics	Intervention	Main Findings
Xiang et al., 2021(4)	Cluster RCT	To evaluate a peer-led oral health intervention based on Health Belief Model and Social Cognitive Theory	1184	Adolescents (secondary school), Hong Kong	Peer-led theory-based intervention vs. booklet-based education	Improved brushing, flossing, plaque index, caries status, and oral health-related quality of life
Ghasemi et al., 2025(7)	Cluster RCT	To assess the effectiveness of a school-based oral health program on caries in Iraqi children	372	Children aged 8–10 years, Iraq	Education + fluoride varnish vs. education only	Significant reduction in caries increment; improved oral health behaviors
Haleem et al., 2012(5)	Cluster RCT	To compare dentist-led, teacher-led, peer-led, and self-learning strategies for OHE	1635	Adolescents aged 10–11 years, Pakistan	OHE by dentist, teacher, peer, self-learning, and control	All educator-led methods improved knowledge and hygiene; peer-led better in behavior change
Karimy et al., 2020(6)	Quasi-experimental controlled study	To evaluate a peer-led oral health education using Theory of Planned Behavior	356	Children aged 11–13 years, Iran	Peer-led sessions with role-play, videos, planning tools	Improved behavior and planning scores in experimental group
Haleem et al., 2016(11)	Cluster RCT	To assess the role of repetition and reinforcement in OHE by different educators	935	Adolescents aged 10–11 years, Pakistan	One-time vs. repeated OHE (dentist/teacher/peer-led)	Reinforcement improved and sustained knowledge, behavior, and hygiene
Aleksejunie ne et al., 2022(9)	Controlled non-randomized trial	To examine peer-led preventive oral health education among elementary students	372	Grades 4–6 students, Canada	Peer-mentoring vs. class lecture	Greater improvement in oral self-care practices and skills in peer-led group

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Karami et al., 2019(13)	Quasi-experimental	Compare peer-led and teacher-led oral health education	120	Female students, 4th grade, Iran	Peer-led vs. teacher-led sessions using educational media and storytelling	Both improved; peer-led better for knowledge, attitude, and practice
Vangipuram et al. 2016(8)	RCT	To compare peer-led and dentist-led oral health education	450	Children aged 12–15, India	Peer-led and dentist-led education vs. control	Both improved oral health; peer-led slightly better in behavior outcomes
Hosseini et al. 2025(12)	Randomized Controlled Trial	To assess the impact of school-based intervention on oral health literacy	140	Female secondary students, Iran	Lectures, Q&A, demonstrations, educational media	Improved OHL across cognitive, behavioral, and communication domains
Taheri et al., 2025(10)	Randomized Controlled Trial	Evaluate intervention based on Bandura's self-efficacy theory	80	12-year-old female students, Iran	4 weekly sessions + booklet + parental checklist	Significant improvements in knowledge, attitudes, practices, and self-efficacy

DISCUSSION

This systematic review evaluate the effectiveness of school based oral health education programs on children oral hygiene, with evidence from randomized controlled trials, and non-randomized studies conducted indifferent populations and settings. The findings indicate that structured oral health education interventions delivered in school environments improve children's oral hygiene practices, plaque indices, and oral health knowledge(4,5,7).

Several included studies show improvements in oral hygiene status after educational interventions. Studies utilizing cluster randomized designs observed reductions in plaque scores and improved brushing frequency post-intervention (10–12). A key feature in effective programs was the use of interactive methods, peer-led teaching, audiovisual aids, and repeated sessions over time (8,13). These findings indicate that oral health interventions are most effective when embedded within the school routine and reinforced regularly over a prolonged period (14).

The quasi-experimental studies highlighted the potential of tailored health education in influencing behaviors, mainly in contexts where full randomization was impractical. One study using the Health Belief Model show significant improvements in perceived susceptibility and oral hygiene behaviors (6). Community-based interventions improve oral health knowledge and motivation, indicating the relevance of behavioral theories in designing effective interventions (9,15).

Structured education improved knowledge and facilitated access to care, mainly when delivered in a culturally sensitive manner (16). Studies evaluating teacher- and peer-involved interventions reinforced their role to enhance behavioral outcomes through

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familiarity and continuity (17,18). Evidence from community settings and special populations showed that brief programs yielded measurable improvements in plaque control and knowledge (15,19).

Short-term gains were less evident for gingival health and caries prevention. Heterogeneity in sample characteristics, intervention duration, content, and outcome measures limited direct comparability in studies. Some studies reported minimal change in gingival indices or caries rates, due to short follow-up periods or absence of reinforcement (7,18). Reliance on self-reported behaviors in some trials introduces potential social desirability bias (4,13).

Risk of bias assessments show that most randomized trials adhered to appropriate procedures in randomization and outcome measurement, some quasi-experimental studies were prone to selection bias and confounding (6,9). These methodological challenges indicate the importance of rigorous study designs and long-term follow-up to evaluate the true sustainability of educational interventions.

This review supports the integration of structured oral health education into school curricula as a feasible and effective method to promote oral hygiene in children. To optimize effectiveness, future programs should incorporate behaviors, cultural adaptations, and reinforcement strategies.

CONCLUSION

This systematic review indicate the positive effect of school-based oral health education (OHE) programs on children's oral hygiene behaviors, plaque reduction, and oral health knowledge. Interventions that include behavioral frameworks, peer-led delivery, and regular reinforcement were more effective.

Our findings supports integrating OHE into school curricula. Engaging families and educators improve program outcomes. Future studies adopt standardized outcome measures and assess long-term effects. School-based strategies contribute meaningfully to prevent oral diseases in children and the promotion of lifelong oral health.

List of abbreviations:
OHE, Oral Health Education; RCT, Randomized Controlled Trial; RoB 2, Cochrane Risk of Bias 2 Tool; ROBINS-I, Risk of Bias in Non-randomized Studies of Interventions; ECOHIS, Early Childhood Oral Health Impact Scale; PI, Plaque Index; DMFT, Decayed, Missing, and Filled Teeth; SES, Socioeconomic Status; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; WHO, World Health Organization; CI, Confidence Interval; SD, Standard Deviation.

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