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2734 17 Avenue SW,
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+15878858911
editorial-office@sciformat.ca

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EFFICACY OF SCHOOL-BASED ORAL HEALTH PROMOTION: A NARRATIVE REVIEW

Dominik Stanislawski (Corresponding Author, Email: dono125115@gmail.com)

Independent Researcher, Warsaw, Poland

ORCID ID: 0009-0009-8583-9895

Natalia Borek

Independent Researcher, Warsaw, Poland

ORCID ID: 0009-0005-7653-7386

Julia Gałzka

Independent Researcher, Warsaw, Poland

ORCID ID: 0009-0007-8675-6181

Ewa Stopa

Independent Researcher, Warsaw, Poland

ORCID ID: 0009-0002-8337-6064

Hanna Krupa

Independent Researcher, Warsaw, Poland

ORCID ID: 0009-0004-4366-8999

Magdalena Kędrak

Independent Researcher, Warsaw, Poland

ORCID ID: 0009-0008-8954-8633

Zofia Wieczorek

Independent Researcher, Warsaw, Poland

ORCID ID: 0009-0001-9850-8464

Emilia Miśkiewicz

Independent Researcher, Warsaw, Poland

ORCID ID: 0009-0003-7756-1981

Wiktoria Jabłońska-Trzosek

Independent Researcher, Warsaw, Poland

ORCID ID: 0009-0004-1466-928X

Jakub Pochwalski

Independent Researcher, Warsaw, Poland

ORCID ID: 0009-0007-6387-5997

ABSTRACT

Childhood oral diseases, such as dental caries, remain globally prevalent. This narrative review synthesizes evidence on the efficacy of school-based oral health promotion programs for children and adolescents (aged 5–18), focusing on knowledge, oral hygiene, and caries outcomes. A literature search of PubMed/MEDLINE, Scopus, and Google Scholar was conducted for English-language systematic reviews, meta-analyses, and clinical trials evaluating school-based preventive interventions. School-based programs consistently improve oral health knowledge and achieve short-term plaque reductions; however, education alone shows limited long-term clinical impact. Sustained clinical outcomes, specifically caries reduction, require multicomponent programs integrating supervised fluoride delivery, parental involvement, and teacher-led reinforcement. Currently, the certainty of evidence remains low to moderate due to study heterogeneity and short follow-up periods. School-based oral health promotion is a viable public health strategy when implemented as a sustained, multicomponent initiative extending beyond the classroom. Future research should prioritize cost-effectiveness, standardized measures, and longer follow-ups, particularly in low- and middle-income settings.

KEYWORDS

School-Based Oral Health Promotion, Dental Caries Prevention, Oral Health Education, Children and Adolescents, Plaque Control

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1. Introduction

School-based oral health promotion has become a crucial component of child health policy, as schools provide equitable access to children during key habit-forming years. Clinical and public health success depends on early intervention to prevent dental caries, plaque accumulation, and gingival inflammation, conditions that can severely impact a child's pain levels, nutrition, school attendance, and overall quality of life (Bramantoro et al., 2021; Hazavehei et al., 2015).

In recent years, multicomponent interventions have emerged as the most promising strategies for addressing these challenges in school settings. While early reviews cautioned that traditional education might only reduce plaque in the short term (Soldani & Wu, 2018), current evidence highlights that comprehensive programs combining interactive education with supervised practice, parental and teacher involvement, and direct preventive services consistently demonstrate greater effectiveness (Ruff et al., 2022; Tai et al., 2009; Yekaninejad et al., 2012). Although the long-term durability of these benefits and the certainty of evidence can vary (Akera et al., 2022), integrated approaches are significantly more likely to produce measurable changes in oral hygiene and caries-related outcomes than brief educational sessions alone (Bramantoro et al., 2021; Das et al., 2025).

On balance, the effectiveness of school-based oral health promotion depends strongly on how it is designed and whether it is linked to home reinforcement and preventive care. Therefore, this narrative review aims to synthesize the current evidence around these interventions, focusing on specific program features, behavioral changes, and clinical outcome domains. Oral diseases remain a major public health concern in childhood, with dental caries and poor oral hygiene contributing to pain, infection, impaired quality of life, and missed school time. Because most children attend school for many years, schools provide a practical and scalable setting for prevention, education, and reinforcement of healthy routines. In this context, school-based oral health promotion has been widely studied as a way to improve knowledge, attitudes, behaviors, and clinical outcomes such as plaque, gingival health, and caries experience (Bramantoro et al., 2021; Hazavehei et al., 2015).

The existing literature suggests that these programs can be beneficial, but their effects depend on how they are designed and delivered. Bramantoro et al. (2021) reported that most included studies showed positive outcomes, especially when interventions involved children, teachers, and parents. Akera et al. (2022) found that primary school-based interventions in low- and middle-income countries were associated with improved dental caries and plaque outcomes, although the certainty of evidence was very low. Earlier reviews were more cautious: Soldani and Wu (2018) found short-term plaque reduction, but insufficient evidence for gingivitis or long-term caries prevention.

Individual trials help explain this mixed picture. In Tehran, a group randomized trial found that interventions targeting both parents and school staff produced more frequent brushing and flossing, with better gingival health than child-only education (Yekaninejad et al., 2012). In Yichang, a cluster randomized trial found reduced caries increment, improved plaque and sulcus bleeding, and better oral health behaviors over three years (Tai et al., 2009). More recent trials have reinforced the value of adding supervised preventive components, such as fluoride varnish, to school-based education; in an Iraqi cluster randomized trial, the intervention group had lower caries development and more favorable oral health behaviors than controls (Gasemi et al., 2024).

Taken together, the evidence points to school-based oral health promotion as a promising strategy, but one whose impact varies with content, intensity, follow-up, and the involvement of families, teachers, and preventive services. A narrative review is therefore useful to bring these findings together and distinguish which program features appear most consistently effective.

2. Materials and methods

This study was conducted as a narrative review of the English-language literature on school-based oral health promotion programs in children and adolescents. A narrative review design was selected in preference to a systematic review given the heterogeneity of study designs, interventions, populations, and outcome measures across the available literature, which precluded formal meta-analytic synthesis while still allowing for a structured, thematic appraisal of the evidence base.

A literature search was conducted across electronic databases including PubMed/MEDLINE, Scopus, and Google Scholar, using combinations of the following search terms: *school-based oral health promotion*, *dental caries prevention children*, *oral health education schoolchildren*, *plaque gingivitis school intervention*, *fluoride school program*, and *oral health knowledge attitudes practices children*. No formal date restriction was applied, though priority was given to studies published from 1995 onwards in order to reflect contemporary school oral health program designs. Only articles published in English were included.

Studies were eligible for inclusion if they reported on oral health promotion or preventive programs delivered within a school setting to children or adolescents aged 5 to 18 years, and if they assessed at least one of the following outcomes: oral health knowledge, attitudes, or practices (KAP); dental plaque scores; gingival health indices; or dental caries experience (dmft/DMFT or dmfs/DMFS). Study designs considered for inclusion encompassed systematic reviews, meta-analyses, cluster randomized controlled trials (cluster RCTs), non-randomized controlled trials, longitudinal cohort studies, and pre-post intervention studies. Studies focusing exclusively on clinical treatment rather than health promotion or preventive education were excluded, as were studies conducted in non-school settings.

Data were extracted thematically and organized according to outcome domain: (1) oral health knowledge, attitudes, and self-reported behaviors; (2) plaque and gingival health outcomes; (3) dental caries outcomes; and (4) the influence of program design features, including delivery agent, parental and teacher involvement, and intervention intensity. Given the narrative nature of the review, a formal risk-of-bias assessment was not applied; however, study design, sample size, follow-up duration, and comparator conditions were considered when interpreting the strength and applicability of individual findings.

3. Research results

3.1. Effects on Knowledge, Attitudes, and Self-Reported Behaviors

Improvement in oral health knowledge is one of the most consistently reported outcomes across the reviewed literature. Several studies report significant gains in children's knowledge following school-based educational interventions, with effects detectable immediately after the program and, in some studies, sustained at short-term follow-up. Blake et al. (2015) evaluated a 60-minute interactive classroom session delivered by dental professionals in three primary schools in the United Kingdom (n=150, aged 9-12 years) and found significant improvements in dental knowledge both immediately post-intervention and at 6 weeks, while improvements in flossing behavior were also observed. Toothbrushing frequency and dietary habits, however, did not change significantly, illustrating that knowledge gains do not translate uniformly into behavioral change.

This gap between knowledge acquisition and behavioral modification has been observed across different settings. Lawal and Taiwo (2017) reported poor baseline knowledge, attitude, and practice scores among 1,297 primary school pupils in Nigeria, and found that previous exposure to oral health education and dental consultations were among the strongest predictors of higher practice scores, suggesting that a single educational contact is insufficient to drive sustainable change. Similarly, Doshi et al. (2024) found significant improvements in knowledge, attitude, and practice scores after a four-week interactive educational program, including an increase in mean brushing frequency from 1.1 to 2.2 times per day.. Although such pre-post designs lack control groups and are therefore prone to overestimating effects, they are consistent in showing a short-term knowledge and behavior response.

When programs are more structured and extend over longer periods, behavioral gains tend to be more robust. Tolvanen et al. (2009) tracked over 1,600 fifth- and sixth-grade students in Finland over 3.4 years and found that children in the oral health promotion group and in the combined risk-strategy group showed greater improvement in most oral health-related behaviors compared to a reference group, with experimental group children demonstrating greater improvement than controls. These findings suggest that sustained, multi-contact interventions may be more successful than single-session approaches in generating lasting behavioral change.

3.2. Effects on Oral Hygiene: Plaque and Gingival Health

Reductions in plaque accumulation represent the most consistently observed clinical outcome in the reviewed literature. A broad evidence base, including systematic reviews, meta-analyses, and individual trials, supports the effectiveness of school-based educational programs in improving oral cleanliness in the short term, although the evidence for sustained effects is weaker.

Soldani and Wu (2018) concluded that traditional oral health educational actions were effective in reducing plaque in the short term, but evidence for an effect on gingivitis was insufficient, and long-term data were absent. Das et al. (2025) similarly reported positive effects of school-based oral health education on plaque and gingivitis reduction, along with improvements in knowledge, attitudes, and behavior, while noting that evidence for caries prevention remained inconclusive.

Individual trials provide more granular insight into the conditions under which these improvements occur. Yazdani et al. (2009) conducted a cluster randomized trial in Tehran among 287 adolescents aged 15, comparing a leaflet-based intervention to a videotape-based intervention. After 12 weeks, 58% of the leaflet group and 37% of the videotape group achieved a positive outcome for oral cleanliness, compared to only 10% of controls, and 72% and 64% achieved healthy gingiva, compared to 30% of controls. Saied-Moallemi et al. (2009) found that parental involvement in a school-based program for 9-year-olds (n=457) was the decisive factor: the parental-aid group showed a strong intervention effect on healthy gingiva, while the classroom-only group did not differ significantly from controls. Shekhawat et al. (2016) confirmed this pattern in children aged 10 to 12 years, finding significant plaque and gingival score reductions across intervention groups and additional benefit from parental involvement for gingival health.

More recently, Gupta et al. (2025) demonstrated in a cluster-randomized trial involving 480 adolescents aged 13-15 that a bimonthly periodontal health education program, which included audiovisual modules, toothbrushing demonstrations, and peer-led activities, produced large reductions in both the gingival index (from 1.89 to 0.91) and the plaque index (from 2.04 to 1.03) in the intervention group, compared to negligible changes in controls. These reductions are clinically meaningful, though follow-up was limited to six months.

3.3. Effects on Dental Caries

The evidence on caries reduction is more heterogeneous than for plaque outcomes. Programs that include supervised toothbrushing with fluoride toothpaste, fissure sealants, or fluoride varnish application tend to show more consistent caries-preventive effects than educational interventions alone.

Akera et al. (2022), in a systematic review and meta-analysis covering 34 studies in low- and middle-income countries, found a statistically significant reduction in dental caries as measured by DMFT scores, with a positive effect also seen on plaque outcomes. However, the authors graded certainty of evidence as very low across all outcomes, limiting confidence in the pooled estimates. Kim and Kim (2024) reported a similar picture, with improved knowledge, behavior, oral hygiene, and gingival health, but noted that most included interventions lasted less than one year and that long-term evidence was still lacking.

In studies with longer follow-up, supervised fluoride toothpaste programs stand out. Al-Jundi et al. (2006) conducted a 4-year longitudinal study comparing 436 children receiving supervised daily toothbrushing with fluoridated toothpaste against 420 controls who received only oral hygiene instructions. Children in the control group were 3.1 times, at age 12, to 6.4 times, at age 6, more likely to have dental caries at the end of four years. Tai et al. (2009) reported that a three-year cluster-randomized trial in Yichang, China showed a significantly lower net mean DMFS increment in intervention schools than in controls. Starr et al. (2020) followed 6,927 children across 33 elementary schools over six years in a comprehensive school-based prevention program that included sealants, fluoride varnish, interim restorations, and oral hygiene instruction, and observed that the prevalence of untreated caries fell from 39% to 18% in the first cohort and from 28% to 10% in the second—reductions of more than 50%.

The evidence is more modest for educational-only programs. Shakir et al. (2021) reviewed eight cluster RCTs of school-based behavioral interventions and found that only one of three trials assessing caries increment demonstrated significant reductions in the intervention group, with another finding benefits limited to high socioeconomic status children and a third actually finding an increase in caries in the intervention group. This heterogeneity underlines the point that education without preventive services has limited impact on caries experience.

3.4. Role of Program Design: Delivery Agent, Parental Involvement, and Intensity

Across outcome domains, program design features consistently modify the magnitude of effects. The involvement of parents emerges as one of the strongest modulators. Yekaninejad et al. (2012) found, in a group randomized trial in Tehran, that the comprehensive group targeting both parents and school staff produced more frequent brushing and flossing and better gingival outcomes than the student-only intervention group, confirming that extending the educational context into the home amplifies in-school effects.

The identity of the delivery agent also matters. Thomas et al. (2000) compared three intervention conditions among 430 children in rural India—children alone, children with teacher involvement, and children with parental involvement—and found the best oral health score improvements in the teacher-involved group. Narayan et al. (2023), in a cluster randomized trial among 12-14-year-olds in a low-resource rural Indian setting, delivered quarterly oral health education, weekly fluoride mouth rinsing, and biannual screening through school health nurses and teachers, resulting in significantly higher improvements in KAP scores, oral hygiene, and gingival bleeding, and a prevented caries fraction of around 23% compared to controls, alongside a nearly threefold increase in dental attendance.

Bramantoro et al. (2021), in a systematic review covering 31 studies from preschool to high school, reported that programs involving children, teachers, and parents together were the most likely to show positive outcomes across all domains—knowledge, behavior, oral health status, and oral health-related quality of life. These findings are consistent with the broader health education literature on the importance of reinforcing messages across multiple social environments.

Finally, intensity and duration are determinants of effect durability. Redmond et al. (1999), in a cluster RCT involving 2,678 adolescents across 28 schools, found that 12 months of the dental health education program produced a sustained 13% reduction in plaque proportion at both the six- and twelve-month assessments, whereas shorter programs are generally associated with larger but less durable gains. The evidence reviewed here is based on an initial search pass, and further searches could surface additional studies across specific age groups, intervention types, or geographic settings.

Table 1 and Table 2 summarize the main findings of the review and the practical program design considerations for school-based oral health promotion.

Table 1. Summary of the main findings from the reviewed literature

	Main finding	Practical takeaway
Knowledge, attitudes, and practices (KAP)	School-based education consistently improves oral health knowledge and self-reported behaviors in the short term, though knowledge gains do not uniformly translate into sustained behavioral change (Blake et al., 2015; Lawal & Taiwo, 2017)	A single educational contact is insufficient; programs should include repeated, structured contacts to support lasting behavioral modification.
Plaque and gingival health	Educational interventions reliably reduce plaque accumulation in the short term; effects on gingival health are more modest and depend on parental involvement and program intensity (Saied-Moallemi et al., 2009; Soldani & Wu, 2018)	Plaque reduction is achievable with basic education, but gingival improvements require parental engagement and sustained reinforcement.
Dental caries	Evidence for caries reduction through education alone is limited and inconsistent; significant caries-preventive effects are observed when supervised fluoride delivery or preventive clinical services are integrated into the program (Al-Jundi et al., 2006; Ruff et al., 2022; Shakir et al., 2021)	Education without a preventive biomedical component has limited impact on caries experience; fluoride programs substantially improve outcomes.
Role of stakeholder involvement	Programs involving children, teachers, and parents consistently produce better outcomes across all domains than student-only interventions (Bramantoro et al., 2021; Yekaninejad et al., 2012)	The school should function as a coordination hub linking education, supervised practice, and home reinforcement rather than as a standalone delivery site.
Certainty of evidence	Most evidence is rated low to very low certainty due to methodological heterogeneity, short follow-up periods, and risk of bias (Akeru et al., 2022; Kim & Kim, 2024)	Findings should be interpreted cautiously; well-designed long-term trials with standardized outcomes are needed to strengthen the evidence base.

Table 2. Summary of program design considerations for school-based oral health promotion

Design category	Recommended features	Clinical/public health significance
Educational content and format	Use interactive, theory-guided approaches (games, demonstrations, peer-led activities) rather than passive classroom instruction; adapt content to age group (Panda et al., 2025; Redmond et al., 1999)	Interactive formats produce more durable behavioral change than traditional didactic teaching alone.
Delivery agents	Involve trained teachers and school health nurses as primary delivery agents, supported by dental professionals for periodic reinforcement (Narayan et al., 2023; Thomas et al., 2000)	Teacher- and nurse-led delivery is effective, sustainable, and feasible even in low-resource settings.
Parental and family involvement	Extend educational messaging into the home through parental education, brushing diaries, and take-home materials (Saied-Moallemi et al., 2009; Shekhawat et al., 2016; Yekaninejad et al., 2012)	Parental involvement is the strongest single moderator of gingival health outcomes and brushing frequency.
Preventive clinical services	Integrate supervised fluoride tooth brushing, fluoride varnish or gel application, fissure sealants, and screening/referral pathways into educational programs (Al-Jundi et al., 2006; Ruff et al., 2022; Tai et al., 2009)	Adding preventive biomedical services substantially amplifies caries-preventive effects beyond education alone.
Program duration and intensity	Design programs as sustained, multi-contact initiatives lasting at least one year; avoid reliance on single-session interventions (Redmond et al., 1999; Tolvanen et al., 2009).	Longer and more intensive programs produce more robust and durable behavioral and clinical gains.

4. Discussion

This narrative review indicates that school-based oral health programs improve children's dental knowledge, hygiene behaviors, and plaque control, though success depends heavily on intervention design. While traditional, single-contact education reliably boosts short-term knowledge, it is generally insufficient for driving sustained behavioral change or long-term gingivitis and caries reduction (Blake et al., 2015; Soldani & Wu, 2018).

Program design features consistently modulate effectiveness, with parental involvement emerging as the most robust moderator for sustained improvements (Saied-Moallemi et al., 2009; Yekaninejad et al., 2012). Engaging teachers and school nurses also yields significant benefits, even in low-resource settings (Narayan et al., 2023; Thomas et al., 2000). Multicomponent models that unite children, parents, and school staff consistently produce the most positive outcomes, positioning the school as a coordination hub linking education, supervised practice, and home reinforcement (Bramantoro et al., 2021).

For caries prevention specifically, education alone has a limited impact (Shakir et al., 2021). The most significant, clinically robust caries reductions are achieved when educational interventions are integrated with preventive biomedical services, such as supervised toothbrushing and routine fluoride applications (Al-Jundi et al., 2006; Ruff et al., 2022; Tai et al., 2009).

The current literature remains constrained by short follow-up periods, methodological heterogeneity, and potential Hawthorne effects (Shekhawat et al., 2016). Because absolute benefits are highest in high-burden, underserved populations, targeting schools in low-income areas can maximize population-level impact (Kim & Kim, 2024). Future research must prioritize long-term, rigorously controlled trials and cost-effectiveness analyses to better translate these findings into health policy.

5. Conclusions

School-based oral health promotion programs are effective in improving children's oral health knowledge, oral hygiene behaviors, and plaque control, with the strongest and most durable outcomes observed in multicomponent programs that combine educational interventions with preventive clinical services and actively engage both teachers and parents (Akera et al., 2022; Bramantoro et al., 2021; Ruff et al., 2022). Future research should prioritize longer follow-up periods, standardized outcome measures, and cost-effectiveness analyses to support the development of evidence-based, contextually adapted programs capable of reducing oral health inequalities at a population level (Shakir et al., 2021; Soldani & Wu, 2018).

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