

## SYSTEMATIC REVIEW

# Effectiveness of oral health interventions for schoolchildren from disadvantaged backgrounds: a systematic review protocol

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**Abstract**

Disadvantaged schoolchildren from rural and low socioeconomic backgrounds face persistent oral health inequalities, specifically dental caries, and periodontal diseases. This protocol aims to review the effectiveness of promotive and preventive oral health interventions for improving the oral health of primary schoolchildren in these areas. We will search the PubMed, MEDLINE, and Cumulative Index to Nursing and Allied Health Literature (CINAHL) via EBSCOhost, Cochrane Library, Web of Science, Dentistry and Oral Sciences databases for studies published from 2000–2023. The review includes randomised/nonrandomised controlled trials and community trials evaluating the effectiveness of promotive and preventive oral health interventions on at least one of these outcomes: changes in dental caries status, periodontal disease status, oral hygiene status/practices, sugar consumption, or smoking behaviours. Two reviewers will independently assess the searched articles, extract the data, and assess the risk of bias in the studies using the Cochrane Risk of Bias 2 (ROB 2) for randomised controlled trials and Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I) for non-randomised controlled trials. Both narrative and quantitative analyses will be conducted. However, only narrative synthesis will be performed if the data are substantially heterogeneous. The synthesised evidence from this review can inform policymakers on evidence-based interventions to improve the oral health outcomes of schoolchildren from rural and low socioeconomic backgrounds. Systematic Review Registration PROSPERO (Registration number: CRD42022344898).

**Keywords**

Child; Dental health education; Low socioeconomic status; Rural population; School dentistry

## 1. Introduction

Children from disadvantaged backgrounds face unique barriers to accessing dental care and are more vulnerable to experiencing oral health inequities [1]. Inequities in health exist in disadvantaged populations, often determined by factors such as lower socioeconomic status and living in rural areas [2]. Lower socioeconomic status (SES) can be defined as those with low income, low educational attainment, low occupational prestige, and low subjective perceptions of social status and social class [3]. Additionally, multiple definitions of rurality exist for both research and policy purposes, however, they are typically characterised by being smaller or less densely populated, and by their distance from larger communities and poorer access to healthcare [4]. Although the role of a rural place of residence in determining health is often intertwined with low socioeconomic status, it often extends beyond that [2]. The geographical location of a rural area itself is often a

critical factor influencing not only the availability of healthcare resources but also in shaping health behaviours and outcomes due to unique environmental and community characteristics.

Despite the variation in the definition of both low SES and rurality in different countries, similarities can be observed globally in the impact of low SES and rurality in influencing health inequities. For instance, in the Netherlands, dental costs are fully covered for children up to 18 years old. Yet, those in low socioeconomic populations consistently exhibit lower percentages of caries-free dentitions and higher mean caries experiences than those from high socioeconomic populations [5]. In Australia, the situation is similar. Indigenous children aged 5 to 10 years have a mean dmfs score of 6.4 (95% confidence interval (CI): 5.4–7.4), which varies significantly across income group, from 2.3 in the highest to 9.1 in the lowest income group. In contrast, non-Indigenous children have a mean dmfs of 2.9 (95% CI: 2.8–3.1), with a range of 1.9 in the highest to 4.2 in the lowest income group [6]. This data

suggests that lower SES significantly impacts dental caries experience in both Indigenous and non-Indigenous children, with a more pronounced effect in Indigenous groups. Furthermore, a systematic review found that children of parents with higher SES have better periodontal status than those from lower SES [7]. Children from non-overcrowded households with better-educated parents also show significantly better gingival conditions [8]. Similarly, a nationwide survey in Malaysia revealed that disadvantaged children from low socioeconomic backgrounds and rural areas have higher prevalence and severity of dental caries and periodontal disease compared to the national average [9]. Poor oral health-related behaviors such as the consumption of sugar-sweetened beverages [10, 11] and cigarette smoking [12] have also been associated with children from rural communities. Therefore, there is an urgent need to prioritise interventions targeted at schoolchildren from disadvantaged backgrounds. This commitment is rooted in addressing health disparities, promoting equity in oral health outcomes, and acknowledging the unique challenges they face, including limited access to healthcare resources, economic constraints, and a higher prevalence of risk behaviours and oral diseases.

The current approach to dentistry, which heavily relies on advanced technology for treatment, may not be practical or achievable for individuals from disadvantaged backgrounds or who lack access to resources. Even in well-resourced areas, dentistry fails to adequately address the needs of a significant portion of the population [13]. It is therefore important for public health strategies to focus on effective interventions that promote oral health and prevent oral diseases to improve the oral health behaviours and outcomes of this target population.

The strategies employed to address disparities in oral health have been diverse. At the population level, extensive research has been conducted on water fluoridation, with most of these studies being published before 1975. A review has concluded that there is insufficient evidence to determine the effectiveness of a water fluoridation programme to improve dental caries among different socioeconomic groups [14]. Additionally, the effectiveness of fluoridated toothpaste and professionally applied fluoridated treatments like varnishes, gels, and mouth rinses has been explored in various populations [15, 16]. Furthermore, interventions such as oral health education (OHE) aim to enhance oral health outcomes by promoting better oral health practices. The method of delivering OHE to the target group is also critical; for example, providing motivational interviewing to caregivers has proven to be more effective in reducing dental caries among children from disadvantaged populations compared to conventional OHE [17]. Moreover, interventions that create a healthier and more supportive environment, such as school-based toothbrushing programmes, have shown positive outcomes for schoolchildren from disadvantaged backgrounds [18]. To bridge the gap in oral health outcomes among different socioeconomic groups, it is essential to adopt a comprehensive healthcare approach that emphasises preventive and promotive measures [19]. This approach should encompass a variety of interventions that address the complex aspects of oral diseases and are customised to meet the specific needs of the disadvantaged population [20].

To date, several reviews have examined the effectiveness of interventions that promote oral health among children at the community, school and individual levels (see **Supplementary Table 1**). The effectiveness of community-based, population-level oral health interventions has been studied; however, this review did not provide insight to address the effectiveness of interventions specifically for children of primary school age from low socioeconomic backgrounds [21]. Similarly, a more recent review examined school-based interventions to improve the oral health of schoolchildren younger than 18 years old [22], and another examined studies aimed at changing oral health related behaviours [23]. However, both of these reviews did not address the differential effects between the different socioeconomic status of the study population. Another comparable systematic review assessed the effectiveness of oral health interventions on disadvantaged children, however in this context, “disadvantaged” referred to children with immigrant origins [24]. One study reviewed the evidence of interventions that reduce inequality in dental caries among children, however, it did not specifically aim primary schoolchildren from rural areas [25]. Additionally, these existing reviews did not include intervention studies that target risk behaviour prevention that is common to both oral diseases and other non-communicable diseases, such as sugar consumption and smoking, which may have the potential to be effective at improving oral health outcomes in this target population. Overall, there is a low number of studies that analyse the effectiveness of oral health promotion programmes for the target population. Thus, this systematic review aims to comprehensively evaluate the effectiveness of promotive and preventive oral health interventions for improving the oral health of primary schoolchildren from rural and low socioeconomic backgrounds. Findings from this systematic review will show whether the promotive and preventive interventions are effective in improving the oral health outcomes of schoolchildren from rural and low socioeconomic backgrounds. For transparency and to facilitate the conduct of this review, this protocol has been developed to provide a detailed outline of the systematic review process.

## 2. Materials and methods

This protocol was developed based on the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) [26] and registered in PROSPERO (Registration number: CRD42022344898).

### 2.1 Development of a research question

The PICO (Population, Intervention, Comparator, Outcome) framework was employed to develop the research question as shown in Table 1.

Based on this framework, the research question is as follows:

“Which preventive and promotive oral health interventions are effective in enhancing the oral health outcomes of primary schoolchildren from rural and low socioeconomic backgrounds?”.

### 2.2 Eligibility criteria

TABLE 1. The PICO framework.

Framework	Concepts
Population	Primary schoolchildren from rural and low socioeconomic backgrounds
Intervention	<p>Preventive oral health interventions:</p> <ul style="list-style-type: none"> <li>• Toothbrushing with fluoridated toothpaste               <ul style="list-style-type: none"> <li>• Topical fluoride</li> <li>• Fissure sealants</li> </ul> </li> <li>• Water fluoridation</li> </ul> <p>Promotive oral health interventions:</p> <ul style="list-style-type: none"> <li>• Oral health education (conventional or game-based, motivational interviewing sessions)               <ul style="list-style-type: none"> <li>• Oral health promotion activities</li> </ul> </li> <li>• School healthy food policies, toothbrushing policies, sugar restriction policies, oral health promotion through common risk factor approach</li> </ul>
Comparator	Comparison group with alternative intervention or no intervention
Outcome	<ul style="list-style-type: none"> <li>• Caries status</li> <li>• Periodontal disease status</li> <li>• Oral hygiene status</li> <li>• Oral health behaviours (<i>e.g.</i>, toothbrushing or flossing practice) and oral health-related behaviours (<i>e.g.</i>, sugar consumption, sugar-sweetened beverage intake or smoking behaviour).</li> </ul>

### 2.2.1 Types of studies

Primary papers of randomised/nonrandomised controlled trials (RCTs) and community trials that examine the effectiveness of promotive and preventive interventions that improve the oral health of primary schoolchildren from rural and low socioeconomic backgrounds will be included. The included studies should be available as full-text documents, written in English or Malay language (Bahasa Malaysia), and published from the year 2000 onwards as we want to assess oral health interventions that are currently being used. The studies should also fulfil the following criteria.

### 2.2.2 Type of participants

Primary schoolchildren from rural and low socioeconomic backgrounds will be included. Primary schoolchildren are defined as children attending primary schools in the respective population or children aged 6–12 years old. A low socioeconomic background refers to children from a low-income household, low parental education level, or within populations that fulfil the income/employment deprivation index according to the respective country's measure of relative deprivation. Rural area is described in the context of poverty, geographical isolation, or deprivation of access to basic needs in health and education.

### 2.2.3 Types of interventions

Studies that assessed the effectiveness of one or a combination of preventive and promotive oral health interventions will be considered, such as the provision of systemic or topical fluorides and school-based oral health programmes. Interventions that assess the effectiveness of risk behaviour prevention will also be included, such as school food policies to reduce the consumption of sugars, or smoking prevention programmes.

The intervention can be performed directly or as a proxy for the children (*e.g.*, parents, teachers, or caregivers) in any setting. To be included, these studies must either compare the interventions with current practice or no intervention as their control group.

### 2.2.4 Types of outcomes

The studies must have one or more of the following outcomes, presenting baseline and post-intervention measurements or changes in the mean/score, at any follow-up period:

- Caries status (*i.e.*, changes or increment in caries incidence, prevalence and experience), including the status of incipient lesions, measured as decayed, missing, and filled deciduous teeth/surfaces (dmft/s), Decayed, Missing, and Filled permanent teeth/surfaces (DMFT/S), or the International Caries Detection and Assessment System (ICDAS).
- Periodontal disease status, including both gingivitis and periodontitis, such as changes or increment in periodontal disease incidence, prevalence, and clinical parameters (*e.g.*, clinical attachment level, probable pocket depth, and bleeding on probing).
- Oral hygiene status, such as changes or increment in plaque scores from any clinical plaque or oral hygiene index.
- Oral health behaviours, such as changes or increment in oral hygiene practices (*e.g.*, toothbrushing or flossing practice) and oral health-related behaviours (*e.g.*, sugar consumption, sugar-sweetened beverage intake or smoking behaviour).

## 2.3 Information sources

Searches will be conducted on PubMed, MEDLINE via EBSCOhost, Cumulative Index to Nursing and Allied Health Literature (CINAHL) via EBSCOhost, Cochrane Library, Web of Science and Dentistry and Oral Sciences databases for

studies published from 2000 to 2023. The reference list of existing systematic reviews relevant to the study will also be searched individually to identify relevant papers.

## 2.4 Search strategy

Before the search in the electronic databases, a list of medical subheadings (MeSH) and text words will be identified from the MeSH databases and relevant systematic reviews and primary papers (see **Supplementary Table 2**). The search strategy will involve only two main concepts, which are the participants of interest and interventions, to ensure that all relevant studies will not be missed. The search will be conducted separately, according to each intervention (refer Table 1). The variation in spelling of both British and American English will also be considered. The search terms will be finalised through discussion with experts in the field and an information specialist from the Universiti Malaya Medical Library. Using Boolean, the search terms within the same concept will be combined using “OR”. Subsequently, we will combine both concepts using “AND”.

## 2.5 Data management

Search results from the databases will be exported to Endnote, where duplicates will be removed. Subsequently, titles, abstracts, and the full text will be screened. The list of all studies will also be copied into Microsoft Excel to record the agreement between review authors.

## 2.6 Study selection

Two reviewers will be appointed. Both reviewers will first undergo a calibration exercise, *i.e.*, pilot testing, in which both will independently screen 100 abstracts against the eligibility criteria. The objective of this exercise is to determine the selection of these studies, aiming to achieve a kappa score of 0.8 or higher. The study selection process will be conducted in two stages. In the first stage, two reviewers will independently evaluate the eligibility of each study based solely on the titles and abstracts. Subsequently, the reviewers will independently review the full text of the eligible studies identified in the first stage. Disagreements at all stages will be resolved through discussion and reaching a consensus. If necessary, a third review author will be involved. The flow of the selection process is shown in Fig. 1.

## 2.7 Data extraction

Data from the included studies will be extracted by two reviewers independently. This will be done using a Microsoft Excel data extraction form that will first be piloted on a minimum of ten primary papers. Disagreements will be resolved through discussion and reaching a consensus or, if necessary, with the involvement of a third review author.

## 2.8 Data items

The data extraction form will include general information (study citation, year of publication, and country), study design, participant characteristics, intervention characteristics, control or comparator group, outcome of interest, and quality assess-

ment. Disagreements will be resolved through discussion and reaching a consensus or, if necessary, with the involvement of a third review author.

## 2.9 Risk of bias in individual studies

The Cochrane Collaboration’s tools for assessment of the risk of bias, Risk of Bias 2 (ROB 2), will be used for randomised controlled trials, and Risk of Bias in Non-Randomised Studies—of Interventions (ROBINS-I) will be used for nonrandomised controlled trials. For randomised controlled trials, ROB 2 will be used to assess bias in five domains; randomisation process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result. For non-randomised controlled trials, ROBINS-I will be used to evaluate bias across seven domains; bias due to confounding, bias in the selection of participants into the study, bias in the classification of interventions, bias due to deviations from intended interventions, bias due to missing data, bias in the measurement of outcomes, and bias in the selection of the reported result. This will be performed by the two reviewers independently, and disagreements will be resolved by discussion and mutual agreement. If needed, a third reviewer will be involved.

## 2.10 Data synthesis

Both narrative and quantitative analysis will be conducted for this review if possible. Meta analyses and sub-group analyses will be performed using RevMan 5.2.1 software (The Cochrane Collaboration) and Comprehensive Meta-Analysis 3.0 software (Biostat, Englewood, N.J., USA) if there are sufficiently homogenous primary studies to provide estimates of the efficacy of the intervention. Dichotomous outcomes will be presented as risk ratios with 95% confidence intervals (CIs), whereas continuous data will be reported in standardised mean differences with 95% CIs. Statistical heterogeneity will be tested using the chi-square test (with a significance level of 0.1) and  $I^2$  statistics, as defined in the Cochrane Handbook for Systematic Reviews of Intervention. The potential source of heterogeneity will be explored by considering the participants, intervention, comparison group, and outcomes, and by visually assessing the forest plots. If the included studies are substantially heterogeneous or there is insufficient data for pooling, a narrative synthesis will be presented to summarise the findings of this systematic review.

## 2.11 Confidence in cumulative evidence

The pooled outcomes will also be assessed for the potential for imprecision, inconsistency, and indirectness of results using the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) guidelines.

## 3. Discussion and conclusion

To address the issue of disparities in oral health outcomes across socioeconomic statuses, it is crucial to implement a holistic approach to healthcare intervention that places priority

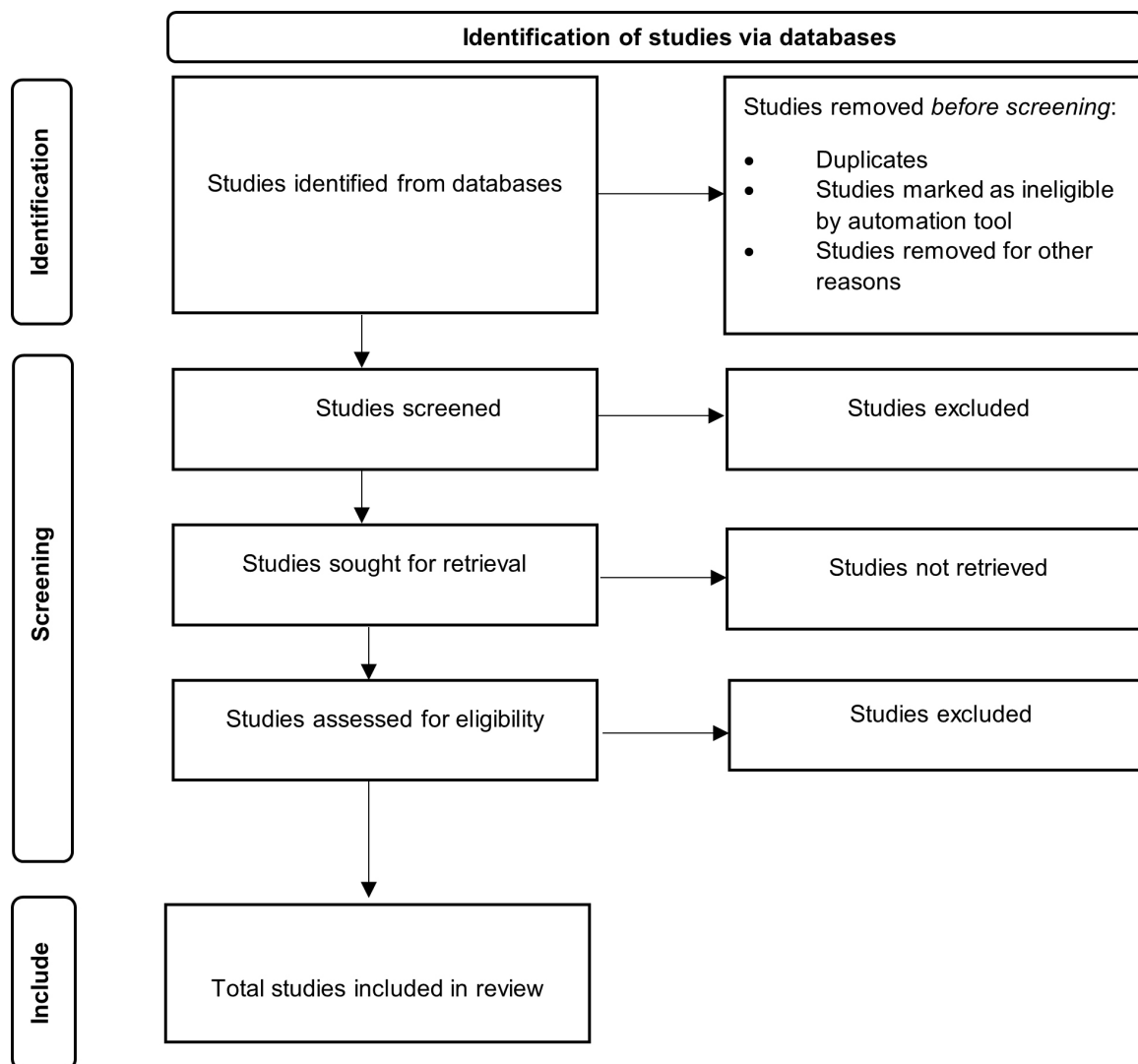


FIGURE 1. The study selection process.

on promotive and preventive measures [14]. Such interventions must consist of a range of interventions that comprehensively and effectively tackle the multifaceted nature of oral diseases [14] and are tailored to the specific needs of the target population [15]. This requires the use of the best available evidence that has been proven to be effective for this target population of disadvantaged schoolchildren.

Thus, this review aims to comprehensively assess the effectiveness of promotive and preventive interventions specifically targeted at disadvantaged populations of primary schoolchildren from rural and low socioeconomic backgrounds, intending to improve their oral health outcomes.

A potential limitation of this review lies in the diversity of outcome measurements, which may result from the range of outcomes included to address the research question. This suggests that the most appropriate method for data synthesis may be a narrative approach. It is important to acknowledge that this approach could introduce reporting bias, as narrative synthesis often lacks the objectivity inherent in quantitative analysis. However, if quantitative analysis is not feasible due to differences in outcome measurements, narrative synthesis will still be useful in highlighting the importance of adopting standardised outcome measurements for future studies. Ad-

ditionally, while this systematic review focuses specifically on the oral health of disadvantaged schoolchildren from rural and low socioeconomic backgrounds, the findings may also apply to children from higher socioeconomic backgrounds in contexts with adequate resources.

The findings of this review can inform policymakers and healthcare providers in designing and implementing evidence-based interventions that specifically target the unique challenges faced by these disadvantaged children. Ultimately, this systematic review can contribute to reducing oral health disparities and promoting equitable access to oral healthcare.

## ABBREVIATIONS

DMFT/S, Decayed, Missing, and Filled permanent teeth/surfaces; dmft/s, decayed, missing, and filled deciduous teeth/surfaces; GRADE, Grading of Recommendations, Assessment, Development and Evaluation; ICDAS, International Caries Detection and Assessment System; OHE, Oral health education; PICO, Population, Intervention, Comparator, Outcome; PRISMA-P, Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols; RCT, Randomised controlled trials; ROB 2, Risk of Bias

2; ROBINS-I, Risk of Bias in Non-randomized Studies of Interventions; SES, Socioeconomic status; SSB, Sugar-sweetened beverage.

## AVAILABILITY OF DATA AND MATERIALS

Data sharing does not apply to this article as no datasets were generated or analysed during the current study.

## AUTHOR CONTRIBUTIONS

ANAT—identified the gap in the current delivery of oral health services and the current systematic review evidence in the literature, and drafted the manuscript. AHKA—formulated the search terms, conducted trial searches on various databases, and revised the introduction section. MJ—designed the methods, and revised the manuscript, particularly in the methods section. ZYMY—conceptualised the study, reviewed the relevant search terms, and revised the manuscript. All authors read and approved the final manuscript.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethics approval was obtained from the Medical Ethics Committee, Faculty of Dentistry, Universiti Malaya (Reference: DF CO2304/0027 (P)).

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## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## SUPPLEMENTARY MATERIAL

Supplementary material associated with this article can be found, in the online version, at <https://oss.jocpd.com/files/article/1808333732125261824/attachment/Supplementary%20material.docx>.

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