



REVIEW ARTICLE

# Evidence based recommendations to improve the children oral health in Saudi Arabia



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## KEYWORDS

Oral health;  
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**Abstract** *Aim:* Identify the existing evidence base with regards to interventions that address high levels of dental caries. A discussion of the applicability of the evidence to possible replication in Saudi Arabia is presented, alongside recommendations to help reduce dental caries rates in children in Saudi Arabia.

*Methods:* A comprehensive systematic review following PRISMA methods was conducted using three databases: MEDLINE via OVID; EMBASE via OVID and Cochrane Library. Studies were included according to inclusion criteria. AMSTAR2 was used to assess the quality of the included studies, while GRADE was used to assess the quality of evidence.

*Results:* Ten studies were included in this review. The quality of these were 'high' (in two review), moderate (in two studies), low (in one study) and to 'critically low' (5 reviews). The quality of the evidence presented by the reviews ranged from 'moderate' to 'very low'. The interventions methods included MI, one-to-one nutrition advice, educational interventions and dental screening. The

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☆ All the authors testify that all persons designated as authors qualify for authorship and have checked the article for plagiarism. If plagiarism is detected, all authors will be held equally responsible and will bear the resulting sanctions imposed by the journal thereafter, it should be notice that this search was part of PhD thesis however, it has been updated up to recent time. Furth more, all authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript. The authors agreed to publish this search.



applicability of the findings in relation to dental care in Saudi Arabia is discussed and summarized in a narrative.

*Conclusion:* No strong evidence that supported interventions to improve the child oral health in Saudi Arabia was found. None of the included reviews included studies conducted in Saudi Arabia or evaluated interventions among the local community. As for different culture values, norms, beliefs and attitude to those demographics explored in the reviews, it is unclear if interventions with improve oral health among Saudi children. Further research is needed to explore the efficacy of these interventions in a Saudi context.

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## 1. Introduction

Several reviews have been conducted in Saudi Arabia to measure the dental caries prevalence in children and all have concluded that there is high prevalence of dental caries among Saudi children (Al Agili, 2013; Al-Ansari, 2014; Alshammari et al., 2021a; Khan et al., 2013). A recent systematic review that was published in 2021 found the rate of dental caries among primary teeth ranges from 0.21 to 1.00 (Alshammari et al., 2021a). Contribution this high prevalence of dental caries among children to the lack of oral health behaviours (al-Banyan et al., 2000; Alaki et al., 2013; Al-Shahrani et al.,

2015). Some studies report that none of their sample brush their teeth (Paul, 2003). Other evidence sought the reasons of this shortage in oral health behaviours, concluding that life style, daily routine, social norms and negligence of the Saudi population is behind this shortage of oral health behaviour (Alshammari et al., 2021b). Other studies contributed the high prevalence of dental caries to the high consumption of sweet food and drinks by Saudi children (Wyne et al., 1995; Farsi, 2010). Furthermore, preventable attendance to dental clinics is very low. Some evidence reported that caregivers and parent argue that there is no need to take a child to the dentist unless the child is suffering from pain (access for treatment not for

preventable purpose) (Alshammari et al., 2021b; Borrelli et al., 2015).

According to Ismail (2004), countries, especially the ones that suffer from high prevalence of dental caries, should institute intervention programmes that aim not only to prevent and treat caries in children but also aim to target children with signs of early carious lesions that may turn into cavities (Ismail, 2004).

An understanding of the level of disease is an important starting point when trying to identify potential interventions for preventing caries within Saudi Arabia. In order to ascertain what interventions might help prevent caries in school children, this work objectives, through evaluation of systematic reviews that has been undertaken to identify interventions that target barriers to good oral health in children. As a result, this paper aims to consolidate a wider oral health research literature in order to develop some evidence-based key recommendations for improving the oral health of Saudi Arabia children. Number of factors that potentially play a role in the high levels of dental caries among the children living in Saudi Arabia. These factors included poor oral health behaviours (e.g. toothbrushing), low levels of preventative dental attendance, and high sugar diets. As a result, this study was to identify the existing evidence base regarding interventions that address these factors. A discussion of the applicability of the evidence to delivery in Saudi Arabia is presented, alongside recommendations to help reduce dental caries rates in children in this setting.

## 2. Methodology

A comprehensive search was undertaken to identify systematic reviews focusing on three research questions:

- What is the effectiveness of interventions to improve oral health behaviours (such as tooth brushing, flossing)?
- What is the effectiveness of interventions to improve preventable dental attendance?
- What is the effectiveness of interventions to improve diets (e.g. decreasing sugar consumption)?

It is not the intention of this work to replicate systematic reviews, but to appraise them to determine how well they have been conducted and how certain we are regarding their findings. The applicability of the findings in relation to dental care in Saudi Arabia is discussed.

### 2.1. Types of studies

This review of the evidence focused on previously published systematic reviews evaluating interventions with the aim of decreasing dental caries. The PICO frame was adopted to this research.

### 2.2. Participants

The participants were: primary school children (aged from 6 to 12 years old), parents, schoolteachers, and oral health provider. Children with complex medical or social care needs were not included.

### 2.3. Intervention

Any intervention addressing one of the three research questions were included. The intervention could be provided by oral health practitioners (dentist or dental hygienist/therapist), schoolteachers, parents, or through mass media and community interventions. The setting for the delivery of the intervention could include schools, homes, dental/health provider or community setting.

### 2.4. Comparator

To be included, evaluated active interventions in comparison to no intervention/placebo or another active intervention.

### 2.5. Outcomes

The primary outcome of interest for each question was dental caries decreasing. As surrogate outcomes, the oral health practice (behaviours), consumption of sugar and preventable dental attendance outcome were considered.

### 2.6. Search strategy

A comprehensive systematic review following PRISMA methods was conducted using three databases: MEDLINE via OVID; EMBASE via OVID and Cochrane Library.

The search was developed for each research question, using a mix of relevant free text and MeSH terms. There was not any restriction to time of publication or language of publication.

### 2.7. Screening for relevance

After running the search strategies (December 2021), all the resulting hits were collected and checked for duplication after sort it in Endnote X9. A double check conducted to catch any duplication that could have been missed by Endnote X9. Titles and abstracts of remaining articles were read separately in order to check for relevance according to the inclusion criteria. Some of the studies did not have enough or had vague information within the abstract (such as children age); these studies were retrieved for further assessment. Irrelevant articles were excluded at this stage. All of the above steps were performed separately for each research question.

### 2.8. Data extraction

Relevant data from those papers were extracted and transferred to a pre-specified data table. Key characteristics recorded for each study included: participants and setting, details of the intervention (including duration), comparison, outcome (including timing of assessment), number of studies included in the review and their design, risk of bias, assessment method and findings.

### 2.9. Assessment the including reviews quality

Included studies were assessed, independently and in duplicate, using the AMSATR2 tool (Shea et al., 2017).

### 2.10. Assessment of the overall strength of evidence presented in identified systematic reviews

We attempted to assess the certainty of the findings presented in each review by using GRADE “Grading of Recommendations, Assessment, Development and Evaluations”. By using this system, we categorised the certainty of the evidence as “high, moderate, low or very low”.

This assessment was undertaken and the findings discussed. When assessing applicability, consideration was given to the feasibility/appropriateness of implementing the findings of the included reviews within Saudi Arabia. Where findings differed across studies, these discrepancies and potential causes were discussed and summarized in a narrative.

## 3. Results

The total number of articles identified across all three-research questions 849 (including duplicates) [Appendix 1](#). It should be acknowledged that there was considerable overlap in the findings from each search.

All search results were imported into Endnote X9. Following removal of duplicates, 250 articles remained. After screening the titles and abstracts of each study, the studies number was decreasing to 73. When facing the remained studies

against the inclusion criteria only ten studies were included in this study ([Fig. 1](#)). Reasons for exclusion included: review focused on preschool children; not systematic reviews; not addressing an intervention relevant to any of the research questions being addressed.

### 3.1. Methodological quality evaluation of included studies

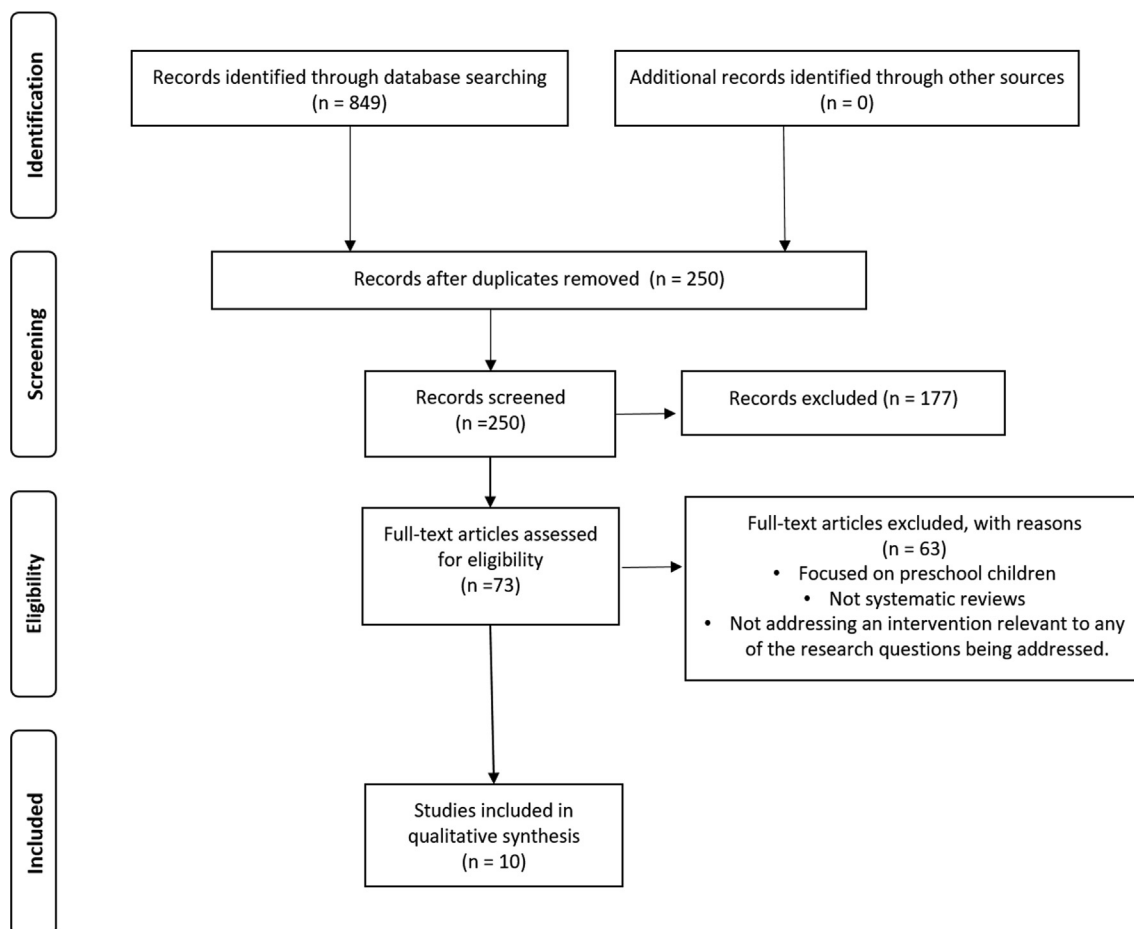
Two studies were considered as high quality and moderate quality consecutively; one review at low quality and five reviews at critically low quality ([Table 1](#)).

### 3.2. Characteristics of included studies

The studies designs included in the included reviews varied, despite all studies evaluating the effectiveness of healthcare interventions ([Tables 2](#)).

Within the included studies, six studies focused on improving oral health behaviours such tooth brushing; three studies focused on improving preventable dental attendance and two studies evaluated interventions to improve diet/reducing sugar consumption in the population of interest.

Seven studies used the Cochrane risk of bias tool; two used the Downs and Black scale ([Downs and Black, 1998](#)). One review did not assess the risk of bias of the included studies.



**Fig. 1** The flow diagram following PRISMA recommendations.

### 3.2.1. Interventions to improve oral health behaviours

Six studies evaluated interventions aimed at increasing the oral health behaviours. The GRADE results of these reviews are presented in [Table 3](#).

### 3.2.2. Interventions for improving oral health behaviours applicable to Saudi Arabia

Among the six studies included in our appraisal, we identified two broad types of intervention: motivational interviewing (MI) and oral health education. MI was assessed in one review ([Borrelli et al., 2015](#)), and was delivered by oral health providers such as dentist or dental hygiene. The authors of this study concluded that this kind of intervention had positive impact regarding oral health behaviours, especially if it included parents and children at the same time. However, the study quality was critically low and the evidence-based quality on GRADE scale was also very low.

Oral health education studies were set in either schools or in health facilities, employing a range of methods including verbal delivery of information (including workshops, lectures or seminars) or delivery through video, posters or leaflets. Across the studies included there was some evidence of effectiveness regarding oral health behaviours and caries outcomes. However, the evidence was typically low/very low certainty. Only one study, ([Cooper et al., 2013](#)) classified as high quality, stated there was not enough evidence to support the effect of oral health education interventions through schools. Furthermore, supervision toothbrushing inside the school which led by teachers or oral health provider was bring up, which have positive benefit especially that it can train children of brushing skills and use fluoride toothpaste.

The applicability of the evidence to the Saudi population is unclear given that none of the studies included were conducted in Saudi Arabia. However, we think that oral health education by either lectures or in person, delivered in a shorter time period, may have some applicability in Saudi Arabia. Further-

more, the use of oral health promotional materials could also be acceptable. Teachers in Saudi Arabia from previous study express their willingness to be part of any preventive programme including toothbrushing supervision that could improve the oral health of the children in their classes. This finding is support by, who evaluated the willingness of teachers in Ha'il city to take part in oral health education programmes in order to improve their students' oral health ([Alshammari et al., 2021b](#)). Whilst there is no strong evidence to support oral health, no adverse events were noted, and if a method of delivery could be identified that was 'attractive' to parents in Saudi, then this may be an alternative approach.

According to the Arab newspaper, Saudi Arabia populations are ranked to be the third people who used the smart phones around the world ([An, 2017](#)). The Saudi MOH stated that adopting text message services to remind people of their appointment in hospital and vaccination schedule have a positive impact, as the missing appointments have dropped to more than half and all people get the vaccination on time. It may be that the use of text messaging technology could be used to deliver oral health messages.

### 3.2.3. Recommendations

The intervention may utilise verbal delivery (e.g. lectures), written/visual material (e.g. posters or videos) or may utilise new techniques such as text messaging of methods. The material could be aimed directly at the children, parents or both. Delivery could be by teachers or oral health practitioners.

### 3.2.4. Diet/sugar consumption

In this appraisal of the evidence we identified two studies that aimed to decrease the dental caries incidence by improving diet through decreasing sugar consumption. The interventions methods were: one-to-one nutrition advice and educational interventions within the health services ([Table 4](#)).

**Table 1** AMSTAR2 outcome results.

Review	AMSTAR2 QUESTION																Overall quality
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
<a href="#">Arora et al. (2019)</a>	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
<a href="#">Borrelli et al. (2015)</a>	Y	N	N	P	Y	Y	N	P	P	N	Y	N	N	Y	Y	N	Critically low
<a href="#">de Silva et al. (2016)</a>	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Critically low
<a href="#">Habbu and Krishnappa (2015)</a>	Y	N	N	N	Y	Y	P	N	P	N	N	N	N	N	N	N	Critically low
<a href="#">Harris et al. (2012)</a>	Y	Y	N	Y	Y	Y	Y	Y	Y	N	N	N	Y	N	N	Y	Moderate
<a href="#">Joury et al. (2017)</a>	Y	Y	N	Y	Y	Y	N	Y	Y	N	Y	N	Y	Y	Y	N	Moderate
<a href="#">Menegaz et al. (2018)</a>	Y	Y	N	P	Y	Y	P	N	Y	N	N	N	N	N	N	N	Low
<a href="#">Priya et al. (2019)</a>	Y	N	N	P	Y	Y	N	N	P	N	N	N	N	N	N	Y	Critically low
<a href="#">Sanjeevan et al. (2019)</a>	Y	N	N	P	Y	N	N	P	P	N	N	N	Y	Y	N	Y	Critically Low
<a href="#">Cooper et al. (2013)</a>	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High

Y- Yes; N – No; P – Partial yes.

AMSTAR2 Classifications:

High: No or one non-critical weakness: the systematic review provides an accurate and comprehensive summary of the results of the available studies that address the question of interest.

Moderate: More than one non-critical weakness: the systematic review has more than one weakness but no critical flaws. It may provide an accurate summary of the results of the available studies that were included in the review.

Low: One critical flaw with or without non-critical weaknesses: the review has a critical flaw and may not provide an accurate and comprehensive summary of the available studies that address the question of interest.

Critically low: More than one critical flaw with or without non-critical weaknesses: the review has more than one critical flaw and should not be relied on to provide an accurate and comprehensive summary of the available studies.

### 3.2.5. Interventions for reducing sugar consumption applicable to Saudi Arabia

The limited evidence to inform the implementation of interventions for improving diet/reducing sugar consumption. Current evidence seems to suggest there is a potential benefit of educational interventions, specifically interactive dietary counselling in older children. Reviewing evidence on reducing sugar consumption in light of the evidence for improving oral health behaviours, it be sensible to use oral health education approaches to combined message on behaviours and diet. The recommendation for children with regard to sugar should be to minimise amount and frequency of sugar consumption. In addition, given there are nationally/internationally accepted recommendations on overall diet, it would seem sensible to promote these. In the UK, for example, the Eatwell Guide provides (Scarborough et al., 2016). clear guidance with regard to sugar consumption in children, they recommend:

That children aged from 4 to 6 years should not intake sugar more than 19 g/day; children aged 7–10 years no more than 24 g/day and from 11 years, including adults no more than 30 g/day.

The WHO in 2018 (Phantumvanit et al., 2018) provide some guidance in terms of implementing such recommendations, including:

- There should be promotion programme aim to improve the consumer knowledge of a healthy intake nutrition;
- In school, there should be programmes that help and encourage children to choose healthy food;
- Children, adolescents and adults should be educated about healthy food and how to consume it;
- The cooking skills among children should be encourage as well, in order to encourage children avoiding fast food;

### 3.2.6. Recommendations

Provisional recommendation (based on very sparse evidence) to promote healthy diet/reduction in sugar consumption through schools and homes can be applicable in Saudi Arabia, we believed adopting this approach will increase consuming healthy food which make good outcome on the person body. Furthermore, adapting approach of balance food tips and advices should be available either through the schools, primary care or the community.

### 3.2.7. Dental attendance

Three studies were identified, which focused on different types of school screening (Table 5).

### 3.2.8. Interventions for dental attendance applicable to Saudi

There is, overall, low/very low evidence regarding school screening approaches. Traditional screening does not, from the current evidence, appear to improve dental preventable attendance. There is some evidence that modified approaches to school screening (e.g. providing a referral letter or with some form of motivation) may improve dental attendance but, again, evidence is of low/very low quality, mainly due to the risk of bias in the included studies. The studies in this area were varying quality, ranging from critically low quality to high quality, but all found similar results.

Some evidence in Saudi reported that children do not visit dentist until there is a need for that visit (Alshammari et al., 2021a,b). Fathers stated that they only take their children to dental clinic to treat them from dental caries when they are in pain. In addition, fathers do not know the current status of their children's oral health. Dental screening with a referral letter could provide the opportunity to raise the issue of the child's oral health status to their parents. If teachers and schools are engaged in improving oral health, it is feasible that this kind of intervention may be effective in Saudi Arabia.

### 3.2.9. Recommendations

The school-screening programme in our opinion will have great impact in Saudi Arabia; we believed this intervention would help in giving the parents an idea about their children oral health status. That will reflect in increasing of the dental clinic attendance.

## 4. Discussion

This study presents a comprehensive assessment of interventions in order to decrease dental caries by means of improving oral health behaviours, decreasing sugar consumption and increasing routine dental check-ups. Half of reviews included in this review scored as 'very low-quality', which may impact the applicability of the results.

It is important to state that, due to poor-quality data, a lot of the recommendations have some basis in the author's subjective experiences. Without reliable studies on the numerous factors playing a role in the issues of dental caries and fluorosis in Saudi Arabia it is impossible for the authors to state with any certainty that his suppositions are correct and there is the possibility of bias. Although, ten reviews were included in this study, however, only two of them were of 'high' quality (Cooper et al., 2013; Arora et al., 2019); two at 'moderate' (Harris et al., 2012; Joury et al., 2017) and one at 'low' quality (Menegaz et al., 2018). The rest of the reviews (the majority) were at 'critically low' quality. This impacted the ability to draw reliable conclusions from the reviews. For example, two reviews (Joury et al., 2017; Sanjeevan et al., 2019) that have the same aim (evaluating dental screening programme intervention), included the same studies and used the same methods for assessment risk of bias disagreed with intervention assessment outcome. (Joury et al., 2017) concluded that there is almost no evidence supporting dental screening programmes in improving attendance to dental clinics. This result was not the same as (Sanjeevan et al., 2019) who stated that it improved attendance to clinics by 16%. However (Sanjeevan et al., 2019), based on assessment by AMSTAR2, is a review of 'critically low' quality. As a result, the present review included in its methods evidence assessment to ensure that interventions be evaluated accurately.

It is also pertinent to again stress that none of the reviews referenced the Saudi cultural context, which greatly differs from the cultural context of the reviews, limiting the confidence with which their recommendations can be applied to Saudi Arabia. As the Saudi people have different culture norms, life styles, beliefs and attitudes, it is unclear as to whether or not the results would be similar in the Saudi context. Some evidence notes teachers and fathers wishing to see school-based intervention (Alshammari et al., 2021b).

**Table 2** The Criteria of the including studies:

Study name	Population, setting and number of included studies	Intervention	Intervention provider	Comparison	Outcomes	Risk of Bias assessment and results of bias assessment
Cooper et al. (2013)	<p><b>Population:</b> School children aged from 4 years old up to 12 years old.</p> <p><b>Setting:</b> Schools</p> <p><b>Included studies</b> 4 RCTs</p> <p>“This review also included behavioural interventions aimed at reducing frequency of cariogenic food and drink consumption. Dental attendance was also reported.”</p>	<p>Behavioural interventions that used the school as the setting of the intervention;</p> <p>*Providing toothbrushing instruction (oral health education)</p> <p>*Supplying some oral health materials (such as toothbrushes and toothpaste)</p> <p>.</p> <p>*Lectures in the classroom with some activities performed in order to improve the oral health behaviours.</p> <p>*Supervised toothbrushing inside the school at least once every three months</p>	Dental professional provider Teachers involved in toothbrushing supervision	Usual curriculum-based health education programmes; or waiting list control groups.	<p>Caries increment (dmft/DMFT or dmfs/DMFS).</p> <p>Plaque scores</p> <p>Frequency of toothbrushing:</p> <p>Frequency of cariogenic food and drink consumption</p> <p>Dental attendance</p> <p>Adverse events</p>	<p>Cochrane risk of bias tool.</p> <p>3 studies at high risk of bias.</p> <p>1 study unclear risk of bias</p>
Borrelli et al. (2015)	<p><b>Population:</b> Parents OR Parents with their children (18 years or younger)</p> <p><b>Setting:</b> N/A</p> <p><b>Included studies:</b> 25 RCTs</p> <p>“In our review we only considered 4 studies as the other studies evaluated non-oral health related outcomes.”</p>	<p>Motivational interviewing (MI) with mean time of 25 min</p> <p>The MI intervention was delivered in person for at least one sitting and by either phone or written material on other sessions.</p>	N/A	No intervention or other active intervention	<p>Modifiable health behaviours including:</p> <p>Oral health,</p> <p>Diet</p>	<p>Assessment undertaken, but tool not stated (Unclear)</p>
Habbu and Krishnappa (2015)	<p><b>Population:</b> Primary school children</p> <p><b>Setting:</b> Primary schools</p> <p><b>Included studies:</b> 11 RCTs</p>	<ul style="list-style-type: none"> <li>Health education or toothbrushing instruction</li> </ul>	N/A	Received intervention AND who did not received intervention	<ul style="list-style-type: none"> <li>Improvement in knowledge, attitude and practices regarding oral health</li> <li>Caries incidence</li> <li>Plaque</li> <li>Gingival bleeding.</li> </ul>	<p>Unclear, although only high scoring trials included</p>
de Silva et al. (2016)	<p><b>Population:</b> Children from birth until 18 years old</p> <p><b>Setting:</b> Settings in which children spend their time or have contact with (e.g. home, childcare, and out of school hours care)</p> <p><b>Included studies:</b> 38 studies:</p>	<p>Any intervention external to dental clinic including:</p> <p>*Oral health education</p> <p>*Oral health promotion</p> <p>*MI</p> <p>*Toothbrushing supervision</p> <p>*Combined/</p>	No restriction with regard to who delivered the intervention	Non-intervention comparison or control group that received usual care or other active intervention; or pre-intervention measures in an interrupted time series design	<p>Dental caries</p> <p>Periodontal disease</p> <p>Self/parent reported oral health status</p> <p>Oral health behaviours</p> <p>Health literacy, knowledge, attitudes and skills</p> <p>Government, organisational</p>	<p>Cochrane risk of bias assessment tools</p> <p>However; no overall risk of bias presented</p>

(continued on next page)

Table 2 (continued)

Study name	Population, setting and number of included studies	Intervention	Intervention provider	Comparison	Outcomes	Risk of Bias assessment and results of bias assessment
	12 RCTs 11 Cluster RCTs 7 Quasi- experimental 1 Matched controlled trial 7 Controlled before-and-after study.	complex interventions			or setting policies	
Menegaz et al. (2018)	<b>Population:</b> Parents with their children OR Children  Setting: Health facilities Included studies: 14 RCTs	Educational interventions	Health professionals: Dentist Medical doctors Nurse	No intervention or other active intervention	Oral health behaviours. Clinical outcomes (caries, periodontal health)	Downs and Black (1998)  The mean score 17.6 out of 27
Priya et al. (2019)	<b>Population:</b> School children aged from 6 to 12 years old  <b>Setting:</b> Primary schools. <b>Included studies:</b> 18 studies: 6 RCTs 12 non-RCTs	Oral health education intervention through the schools by: Lectures, Workshops Activities regarding oral health behaviours	Oral health professionals Teachers Parents	No intervention or other active intervention	Oral health behaviours.  Dental caries.  Periodontal health	Cochrane risk of bias tool: 3 RCTs at low risk of bias 3 RCTs at moderates due to unclear of blinding 9 non-RCTs at low risk of bias 2 non-RCTs at moderate risk of bias 1 non-RCTs at high risk of bias (missing participants) Cochrane risk of bias tool
Harris et al. (2012)	<b>Population:</b> Adults and children of all ages  <b>Setting:</b> any setting providing dental care. <b>Included studies:</b> 5 RCTs	One-to-one dietary intervention	Any dental care provider	No intervention or other active intervention	Consumption of sugary/low sugar foods, chewing gum, drinks and other types of food. Consumption of non-milk extrinsic sugars and intrinsic sugars (fruit) and other sugars, sucrose, glucose, xylitol and other intense sweeteners were recorded. Caries Tooth erosion	2 RCTs high risk of bias  3 RCTs unclear risk of bias



**Table 3** Evidence regarding interventions to improve oral health behaviours.

Study name	GRADE Overall results	GRADE evidence certainty rating and GRADE rating explanation	OVERALL SUMMARY
Cooper et al. (2013)	<b>Any behavioural intervention vs usual curriculum/delayed intervention</b> Caries - DMFS (prevented fraction (PF)) at 15 month follow-up: PF = 0.65 (95% CI 0.12 to 1.18) (1RCT; 60 participants)	<b>Low</b>	There is low certainty evidence that behavioural interventions in a school setting are effective in terms of clinical outcomes. There is insufficient evidence to determine whether such interventions improve oral health practices.
Borrelli et al. (2015)	<b>MI vs comparison groups:</b> Oral health effect size = 0.38 (95% CI 0.08, 0.68)	<b>Very low</b> “Downgraded due to unclear risk of bias, indirectness (age groups not directly applicable) and Heterogeneity”	There is very low certainty evidence with regard to the effectiveness of MI for improving oral health practices and preventing caries.
Habbu and Krishnappa (2015)	<b>No statistical pooling was undertaken across any outcome.</b> <b>Dental caries</b> One study reported on dental caries. A difference of 21.6 lesions per 1,000 children between control and test groups was observed <b>Toothbrushing skills</b> Two studies reported an increase in surfaces brushed  Knowledge, attitudes and oral hygiene behaviours One study reported a positive impact on behaviours but less impact on knowledge/attitudes.	Not undertaken; insufficient information by outcome	There is verily limited evidence with regard to the effectiveness of oral health education or toothbrushing instruction on caries levels, toothbrushing skills or knowledge, attitudes and oral hygiene behaviours
de Silva et al. (2016)	<b>Oral health education alone:</b> DMFT mean difference 0.12 (95% CI 0.11 to 0.36; two studies) dmft mean difference – 0.3 (95% CI – 1.11 to 0.52; three studies) DMFS mean difference – 0.01 (95% CI – 0.24 to 0.22; one study) <b>Oral health education in combination with supervised toothbrushing with fluoridated toothpaste</b> dmfs mean difference – 1.59 (95% CI – 2.67 to – 0.52; three studies) dmft mean difference – 0.97 (95% CI – 1.06 to – 0.89; two studies) DMFS mean difference – 0.02 (95% CI – 0.13 to 0.10; two studies) DMFT mean difference – 0.02 (95% CI – 0.11 to 0.07; three studies) <b>Oral health education with professional preventive oral care</b> DMFT mean difference – 0.09 (95% CI – 0.1 to – 0.08; two studies)	<b>Low quality<sup>1</sup></b>  <b>Low quality<sup>1</sup></b>  <b>Very low<sup>2</sup></b>	Very low to moderate certainty evidence with regard to the effectiveness of community-based oral health promotion. Significant concerns regarding the methods used within the review.

(continued on next page)

Table 3 (continued)

Study name	GRADE Overall results	GRADE evidence certainty rating and GRADE rating explanation	OVERALL SUMMARY
		Low quality <sup>1</sup>	
		Low quality <sup>1</sup>	
		Low quality <sup>1</sup>	
		Moderate quality <sup>2</sup>	
		Very low <sup>2</sup>	
		1) Downgraded due to serious risk of bias and indirectness.	
		2) Downgraded due to serious risk of bias, indirectness and imprecision	
Menegaz et al. (2018)	<p><b>Oral health behaviours</b> No pooling of data undertaken. 6 studies evaluated daily brushing at least twice a day; five studies presented positive results in favour of educational interventions (11.0% to 141.5% improvement)<sup>0</sup>. 6 studies evaluated sweet consumption; five of the 6 studies demonstrated improvement (7.6% to 83.3% improvement) 3studies evaluated use of dental services; all found improvement.</p> <p><b>Clinical outcomes</b>11 studies evaluated the prevention of new lesions/cases of caries; only five presented significant decrease in caries (31.6% to 481.6% decrease)<sup>0</sup>. 2 studies evaluated dental plaque and one evaluated dental calculus; all showed positive results</p>	<p>Not undertaken; insufficient information by outcome</p>	<p>Although some outcomes show improvements, the clinical heterogeneity of the studies included makes it difficult to draw conclusions. Evidence is uncertain, but promising, regarding the effect of education intervention on improvements in oral health-related behaviours and on clinical outcomes</p>
Priya et al. (2019)	<p>No pooling of data undertaken. The authors provide a narrative describing the studies included; large variation in study characteristics hampers interpretation. Broad statements regarding the improvement in oral health-related knowledge, practice behaviours such as frequency and duration of brushing improved, clinical outcomes and diet are made, but not linked to specific interventions. There are some suggestions that dentist-, teacher-, and peer-led educators were more effective than self-learning.</p>	<p>Not undertaken; insufficient information by outcome</p>	<p>Evidence is uncertain regarding the effect of education interventions on improvements in oral health-related behaviours and on caries conditions</p>

Based on these sentiments, it is possible to state that a school-based programme might have a positive impact on Saudi child oral health and habits. Furthermore, a screening programme would help parents to know the status of their child's oral health.

This paucity of reliable evidence poses difficulties on the level of public health and policy. Without accurate and reliable data, it is extremely difficult to pinpoint the most pertinent issues that would see the greatest returns when addressed by interventions. Taking the issue of fluorosis, for example, without recent data on water fluoride levels and the prevalence of fluoride toothpaste, it is possible that an intervention seeking to promote toothbrushing amongst primary-school children may have the adverse effect of increasing rates and severity of fluorosis (Alshammari et al., 2021c). On the clinical level, it is also difficult for a dental practitioner to make recommendations to his/ her patients, as recommending a fluoride toothpaste to reduce recurrent caries may have sub-optimal results if, in fact, the drinking water in the area has the high levels that are documented by some of the studies reviewed in this research. It is therefore vital that further reliable surveys are conducted into the actual levels of fluoride in the drinking water in KSA. In the same term, it is also extremely difficult to make policy and public health recommendations without robust data on the causes of dental caries in Saudi Arabia.

The authors of the present work are a Saudi citizen, and as such it is important to recognise that a great deal of information on the causes of caries, such as its attribution to a cultural tendency to over-indulge in sugary foods, is based on anecdotal experiences and speculation. It is entirely possible that the author's experiences of life in Saudi Arabia are limited geographically and socio-economically, and any that extrapolation of his lived experience as representative of the 'norms' of Saudi culture and dietary habits is an unsound foundation

on which to base policy and public health initiatives. As such, there is a need for quantitative studies into the dietary and oral health habits across the spectrum of Saudi society.

As a result, new strategies for delivering this intervention in Saudi Arabia are required, such as a training programme for the dental staff who oversee providing this intervention. As this kind of professionally provided intervention is already in place in the form of the preventive school programme of Saudi Arabia, it was not included in this study. Furthermore, it did not meet the aims of this study, which aimed to find interventions to improve oral health practices amongst children in the home setting.

Toothbrushing is only effective as a long-term intervention if it is conducted on a regular basis, at least twice a day. In order to inculcate such a habit, any toothbrushing intervention would have to take place daily in schools, which would require support from teachers and other stakeholders. Teeth also require brushing in the evening, which would require parental supervision and buy-in. Therefore, without parental engagement and education, one might doubt the effectiveness of school-based toothbrushing initiatives in instilling lasting habits, as there is little incentive for parents to accurately conduct or report toothbrushing in the home.

Whilst there is evidence of effectiveness of some interventions, there needs to be further research conducted within Saudi Arabia, or populations directly applicable to Saudi Arabia, in order to determine the most effective interventions for preventing caries in school aged children. In particular, there is a need to evaluate school-based programs. Furthermore, oral health motivation interviews by health professional and other appropriate professionals should be assessed as well. Interventions to encourage preventative/routine visits to the dental clinic could also be evaluated.

**Table 4** Evidence regarding interventions for reducing sugar consumption diet/sugar consumption.

Study name	GRADE Overall results	GRADE evidence certainty rating and GRADE rating explanation	OVERALL SUMMARY
Harris et al. (2012)	<p><b>One-to-one dietary intervention versus no intervention</b> No meta-analysis was performed. Two studies compared baseline and follow-up and found reduced sugar intake but they did not compare across groups.</p> <p><b>One-to-one dietary intervention versus another dietary intervention</b> A multicomponent intervention with 11–12-year-olds did not analyse across groups. Caries – data not reliable due to drop-outs Sugar consumption – increased use of xylitol products more than 3 times a day</p>	<p><i>Not reliable</i></p> <p><b>Moderate</b> “Downgraded by one level due to single small study.”</p>	<p>There is very little reliable evidence available to draw conclusions about effects of dietary interventions in the dental setting for reducing sugar consumption or making other beneficial dietary changes. Moderate evidence suggests interactive dietary counselling with 11- to 12-year-olds may increase their use of xylitol products.</p>
Menegaz et al. (2018)	<p><b>Sugar consumption</b> No pooling of data undertaken. Authors report a significant reduction in sugar consumption in 5/6 studies</p>	<p>Not undertaken; insufficient information by outcome</p>	<p>Although some improvement in sugar consumption reported, the clinical heterogeneity of studies included makes it difficult to draw conclusions.</p>



**Table 5** (continued)

Study name	GRADE Overall results	GRADE evidence certainty rating and GRADE rating explanation	OVERALL SUMMARY
Sanjeevan et al. (2019)	<p><b>Dental clinic visits improvement due to screening</b>[RR 1.16 (95% CI 1.11–1.21)]; (Chi-square = 137.26, df = 4, <math>P &lt; 0.0001</math>, <math>I^2 = 97\%</math>)</p> <p><b>Dental visit improvement due to referral litter without screening</b> [RR 0.97 (95% CI 0.92–1.02)] (df = 1, <math>P &lt; 0.09</math>, <math>I^2 = 65\%</math>).</p> <p><b>Dental visit improvement due to traditional screening and referral litter</b>[RR 1.10 (95% CI 1.05–1.16)] (df = 1, <math>P &lt; 0.0002</math>, <math>I^2 = 93\%</math>)</p>	<p>Very Low</p> <p>Very Low</p> <p>Very Low</p>	<p>Evidence is uncertain regarding the effect of screening either “traditional one or with a referral litter intervention on improving the dental visit (Certainty of the evidence is very low)</p>

They were downgraded due to risk of bias and imprecision

## 5. Conclusion

We could not find strong evidence that support intervention to improve the study questions. However, all the including reviews in our study did not include study conducted in Saudi Arabia or evaluate intervention among Saudi Arabia community. As Saudi Arabia have different culture values, social norms, beliefs and attitude those intervention may improve oral health among Saudi children. This request studies to be sure if it works or not.

## 6. Author's contributions

FA; AS, HK and MA: conceived and designed the study, conducted research, criticism the including studies and wrote the final manuscript.

FA; MoA and HA: analyzed and interpreted data.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Knowledge Transfer Statement

*“The results of this study can be used by policy makers and oral health provider to improve the oral health of Saudi children. It is also highlighting the important of conducting future research in preventive area”*

## Appendix 1. The total results of search

Database	Oral health behaviours	Sugar consumption	Access to dental services	Total
MEDLINE via Ovid	265	42	58	365
EMBASE via Ovid	350	8	79	437
The Cochrane Library	27	7	13	47
Total	642	57	150	849

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