Submitted: 24 October, 2023 Accepted: 29 March, 2024 Published: 03 September, 2024 DOI:10.22514/jocpd.2024.101

SYSTEMATIC REVIEW

Journal of Clinical Pediatric Dentistry

# Effectiveness of silver diamine fluoride (SDF) in arresting coronal dental caries in children and adolescents: a systematic review

Satish Vishwanathaiah[1,*,†], Prabhadevi C Maganur[1,†], Ather Ahmed Syed[1], Ateet Kakti[2], Atlal Hassan Hussain Jaafari[3], Dhalia H Albar[1], Apathsakayan Renugalakshmi[1,4], Ganesh Jeevanandan[4], Zohaib Khurshid[5], Hosam Ali Baeshen[6], Shankargouda Patil[7,8,*]

[1]Department of Preventive Dental Sciences, Division of Pedodontics, College of Dentistry, Jazan University, 45142 Jazan, Saudi Arabia
[2]Department of Pediatric Dentistry and Preventive Dentistry, Riyadh Elm University, 12734 Riyadh, Saudi Arabia
[3]Dental school, Jazan University, 45142 Jazan, Saudi Arabia
[4]Department of Pediatric and Preventive Dentistry, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, 600077 Chennai, India
[5]Department of Prosthodontics and Dental Implantology, College of Dentistry, King Faisal University, 31982 Al-Ahsa, Saudi Arabia
[6]Department of Orthodontics, Faculty of Dentistry, King Abdulaziz University, 21589 Jeddah, Saudi Arabia
[7]College of Dental Medicine, Roseman University of Health Sciences, South Jordan, UT 84095, USA
[8]College of Graduate Studies, Roseman University of Health Science, South Jordan, UT 84095, USA

***Correspondence**
spatil@roseman.edu
(Shankargouda Patil);
drvsatish77@gmail.com
(Satish Vishwanathaiah)

[†] These authors contributed equally.

## Abstract

Dental caries remains a significant public health issue for children globally, leading to adverse effects on health and development. Silver diamine fluoride (SDF) is a potential preventive agent that can prevent caries progression in children. This systematic review examined the effectiveness of silver diamine fluoride in arresting caries compared to other fluorides. An electronic search of MEDLINE, PubMed, EMBASE, Cochrane, Web of Science, Scopus databases was carried out examining articles in English from 2001 to 2023. Studies included in the analysis examined the application of SDF in children and adolescents with coronal caries lesions on primary teeth or permanent first molars. Fifteen studies, involving a total of 7895 children, were incorporated. The application regimen varied across studies. Most studies in this review consistently suggested that SDF is effective in arresting caries. An annual application of SDF effectively reduced *Streptococcus mutans* count. Adverse effects were primarily tooth staining and less commonly, oral mucosal irritation. A majority of studies showed a high risk of bias due to methodological insufficiencies. Overall, the evidence suggests that SDF is effective in arresting dental caries in children. It offers a viable, cost-effective, and minimally invasive treatment option, particularly suitable for use in low-resource settings. However, the aesthetic concern of tooth staining with SDF use remains a challenge. Further well-designed clinical trials may provide a fuller picture of SDF which can shape public health policy and shift towards a minimally invasive treatment approach.

## Keywords

Arresting caries; Black staining; Dental caries; Early childhood caries; Silver diamine fluoride; Systematic review

## 1. Introduction

Dental caries is a preventable chronic disease affecting children across the globe [1]. The consequences of untreated dental caries are far-reaching. Severe pain may lead to difficulty in eating and reduced nutritional intake, poor academic performance, affect behavior, and take a toll on their growth and development [2–6]. This preventable disease also places a consequential economic burden on the population [7–9]. The high prevalence of early childhood caries globally has an irrevocable impact on the health and well-being of children [10, 11]. Despite this, early childhood caries remains largely untreated in children owing to several factors ranging from lack of knowledge to lack of access to healthcare in marginalized communities [12, 13]. Early Childhood Caries (ECC) can be a treatment challenge in especially children where lack of cooperation can affect the delivery of conventional treatment or delay it, necessitating a surgical approach [14, 15]. When conventional dental treatments may be unfeasible or inaccessible, carious lesions may be managed and arrested using minimally invasive, cost-efficient, readily available fluorides [16]. Fluorides serve to arrest caries by interfering with the carious process [17–19].

Silver diamine fluoride (SDF) is a preventative agent that penetrates the enamel and inhibits the growth of cariogenic bacteria [20]. SDF renders the enamel less soluble to the action

of bacterial acids and converts the soluble hydroxyapatite into fluorapatite while simultaneously acting against the causative bacteria [21]. SDF may also have a greater degree of fluoride retention compared to other topical fluorides [22] and prevent biofilm formation [23]. Evidence from *in vitro* studies suggests that SDF may be capable of arresting caries progression in primary and permanent teeth [24, 25]. The utilization of light emitting diodes (LED) light resulted in the acceleration of silver penetration [26]. SDF has better stability and less oxidizing effect in the diamine-silver complex compared to the silver fluoride, and the position of equilibrium lies within the diamine-silver ion [27]. For this reason, SDF is generally used in high concentrations (38%) as a means of arresting and preventing the progression of dental caries in an off-label capacity [28]. *In vitro* studies have demonstrated that SDF has antibacterial properties, has the potential to increase the pH of biofilm, decrease dentin demineralization, and exhibit antimicrobial action against cariogenic bacteria, thereby terminating its growth [29]. It has received approval from the Food and Drug Administration (FDA) in the United States for use as a caries prevention agent [30]. Several studies have focused on the effectiveness of silver diamine fluoride in controlling caries [31–34]. The recommendation stands at using a 38% concentration SDF solution as a semiannual application [35]. This systematic review examined the comparative effectiveness of 38% SDF against various interventions in preventing the progression of coronal carious lesions in primary and permanent teeth among children and adolescents.

## 2. Materials and methods

This systematic review was conducted based on the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines [36]. This review was submitted for registration in the International Prospective Register of Systematic Reviews (PROSPERO) Registration Number: CRD42022337564. The research question stated in the PICOS format is Population (P): Children and adolescents with coronal caries lesions on primary teeth or permanent first molar, Intervention (I): 12% and 38% SDF application every 6th and 12th month, Comparison (C): Any caries reduction agent, Outcome (O): mean number of arrested carious lesions, percentage of inactive carious lesions, caries incidence, caries arrest rate, mean depth of lesions, caries increment, count of *Streptococcus mutans*, Study (S): Randomized controlled trials, non-randomized controlled trials.

The focus question was: "Does the application of SDF arrest cavitated coronal caries lesions as effectively as other treatment modalities in primary and permanent teeth among children?"

### 2.1 Eligibility criteria

This review centered on children with cavitated caries lesions on primary teeth or permanent first molars. The intervention examined was SDF, comparing it with any caries reduction agent. Emphasizing caries arrest as the primary outcome, the study exclusively included randomized controlled trials and non-randomized controlled trials for a comprehensive evaluation published in the English language.

### 2.2 Search strategy

Electronic databases such as PubMed, Web of Science, Scopus, Embase, Google Scholar and Saudi Digital Library were searched for articles published after 2001 to 2023, The search strategy was developed using a combination of keywords and MeSH terms relevant to "Silver diamine fluoride (SDF)", "dental caries", "children", "adolescents" and "randomized controlled trials". The search was limited to studies published in English. Grey literature was explored through the OpenGrey database, and reference lists of included studies and relevant reviews were manually searched to identify additional studies. Two authors independently assessed the search results for study selection (SV, PCM).

### 2.3 Study selection

Published articles that discuss the effects of SDF in preventing caries in primary teeth and permanent first molars among children and mention the assessment tool were included. Studies that did not consider SDF as an intervention, articles with other study designs, or published in any language other than English were excluded. The authors independently screened abstracts and titles after the removal of duplicates for inclusion in the review. Any disagreements were resolved through discussion with a third author (GJ).

### 2.4 Data extraction

Data extraction was carried out independently by two reviewers (VM, SGP) using a customized form designed to ensure a comprehensive and consistent collection of relevant information. The data extracted encompassed study specifics, such as authorship, publication year, geographical location, design and participant number. Detailed information regarding the SDF intervention, including concentration, application frequency and duration, along with any additional treatments, was documented. We focused on outcomes related to the arrest of caries and adverse reactions. Disparities in the extracted data were collaboratively discussed and resolved by the involved reviewers, and third-party consultation (GJ) was sought when necessary.

### 2.5 Quality assessment

The quality of the selected studies was assessed using relevant guidelines from the Cochrane Handbook for Systematic Reviews [37] by two authors independently (RGR, VM). Any disagreements were resolved through discussion with a third author (SV) till a consensus was reached. Risk of Bias 2 (RoB2) was used to assess randomized control studies. The possible risk of biased judgments is low, some concerns, and high risk of bias. Five specific domains were used to assess the external and internal validities of the studies including randomizations, allocation concealment, missing outcome data, outcome measurement and selective reporting.

ROBINS-I (Risk of Bias In Non-randomised Studies of Interventions) was used to examine non randomized studies. The response for each domain was serious, low, moderate,

critical risk of bias or no information. The absence of pertinent information regarding methodology in the selected study would result in a no information judgment for the domain. The overall risk of bias was determined using the highest level of risk observed under the domains.

## 3. Results

The systematic search across multiple databases and registers yielded a total of 248 records. A manual search strategy identified an additional 3 records. After the initial search, 177 duplicate records were removed. Detailed screening led to the exclusion of 52 records based on the titles and abstracts. 19 reports were sought for full-text retrieval and further assessment. Based on the inclusion criteria, 17 reports were considered for inclusion. In total, 15 studies met the inclusion criteria and were incorporated into the systematic review. The search and study selection is depicted in Fig. 1.

Most of the studies were conducted in China (6 (40%)) [31, 38–42], followed by India (3 (20%)) [43–45], Egypt (2 (13.33%)) [46, 47] Nepal [48], Cuba [49], Philippines [50] and Thailand [51]. The study durations ranged between 6 to 30 months. The fifteen studies examined a total of 7895 children ranging in ages from 3 to 10 years. A summary of the characteristics of the included studies is presented in Table 1 with a predominant focus on qualitative results, and the absence of consistent quantitative data is acknowledged. Despite this constraint, the authors diligently conveyed the available information from each study within the confines of the presented data.

### 3.1 Quality assessment

Within the overall risk of bias among the studies, a substantial number of trials were deemed to have a high risk of bias or show some concerns due to methodological insufficiencies. Specific issues noted in these trials included differential missing data, inadequate information concerning deviation from trial protocols, or attrition, which could potentially influence the outcomes. The trials with a low risk of bias generally demonstrated better quality in reporting as compared to those with a higher risk. A detailed risk of bias along with a summary assessment of the risk of bias is presented in Fig. 2 (RoB2) [52] and Fig. 3 (ROBINS-I) [53].

### 3.2 Outcome measures

The outcome measures aimed to evaluate the efficacy of SDF in arresting and controlling coronal caries in the pediatric population varied among the studies, ranging from either assessing carious lesion activity, *Streptococcus mutans* count, caries arrest rate, the mean number of new decayed surfaces, mean number of non-vital teeth to mean the number of new dentinal caries. The most common measure was the evaluation of the mean number of carious lesions [31, 38–42, 46–51] while the three other studies examined the mean depth of lesions [43], *Streptococcus mutans* count [44], and fluoride content [45].

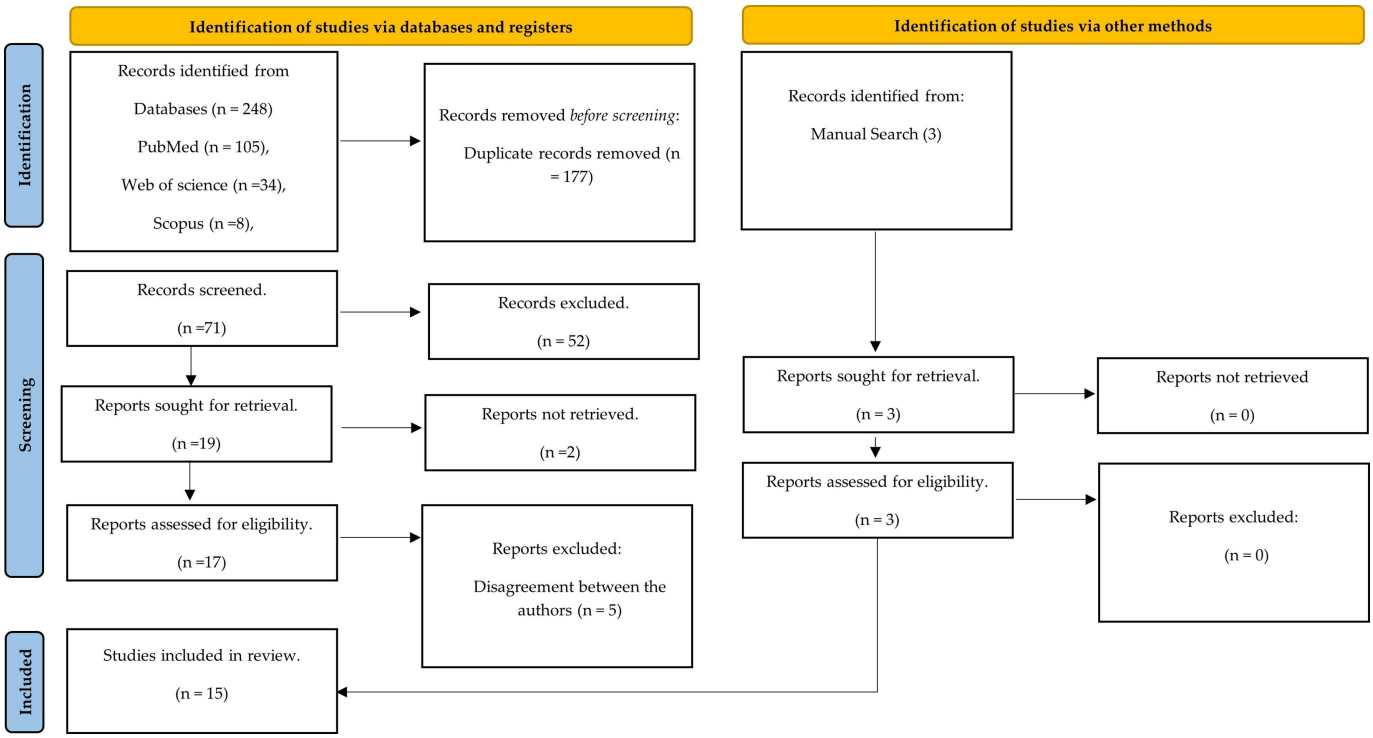


**FIGURE 1. PRISMA 2020 flow diagram for new systematic reviews which included searches of databases, registers and other sources.**

**TABLE 1. Characteristics of selected studies.**

| Author | Year | Study | Samples type | Study Design | Type of dentition | Comparison | Outcome assessment | Adverse events | Results |
|---|---|---|---|---|---|---|---|---|---|
| Lo *et al.* [41] | 2001 | NRCT | 375 children, 3–5 yr, Primary teeth | Grp 1: SDF+ excavation<br>Grp 2: SDF<br>Grp 3: NaF+ excavation | Primary dentition | 5% NaF | Mean number of arrested carious lesions | SDF application resulted in black staining | Children who got a yearly application of SDF had a higher number of caries lesions that were halted in their progression compared to children in other groups. Removing cavities beforehand does not impact their capacity to halt dentin caries. The yearly use of SDF solution shown to be more efficient in the process of strengthening or stopping tooth decay in dentin compared to the use of 5% NaF varnish. |
| Chu *et al.* [38] | 2002 | NRCT | 375 children, 3–5 yr | Grp 1: SDF + excavation<br>Grp 2: SDF<br>Grp 3: NaF + excavation<br>Grp 4: NaF<br>Grp 5: Control | Primary dentition, and permanent first molars | 5% NaF | Mean number of arrested carious lesions | SDF application resulted in black staining | The group of children who got a yearly treatment of SDF had a higher number of caries lesions that were halted in their progression compared to the other groups. The application of SDF successfully halted the progression of dentin caries in primary anterior teeth in preschool children. |
| Llodra *et al.* [49] | 2005 | RCT | 425 children, below 6 yr | Grp 1: SDF application every 6 mon for 36 mon.<br>Grp 2: Control | Primary dentition | Placebo | Percentage of inactive carious lesions | SDF application resulted in black staining. Small, mildly painful white lesion in the mucosa | The children in the SDF group had a higher number of tooth surfaces with non-active tooth decay in both their primary teeth and permanent molars. Overall effectiveness of SDF treatments was higher in deciduous teeth (80%) compared to first permanent molar teeth (65%). A 6-mon treatment is effective in managing tooth decay in baby teeth and first permanent molars. |

**TABLE 1. Continued.**

| Author | Year | Study | Samples type | Study Design | Type of dentition | Comparison | Outcome assessment | Adverse events | Results |
|---|---|---|---|---|---|---|---|---|---|
| Yee *et al.* [48] | 2009 | RCT | 976 children, 3–9 yr | Grp 1: 38% SDF for 2 min without a reducing agent<br>Grp 2: 38% SDF with tea as reducing agent<br>Grp 3: 12% SDF for 2 min, without a reducing agent<br>Grp 4: No treatment for carious teeth. Control group | Primary dentition | 12% SDF | Mean number of arrested carious lesions | SDF application resulted in black staining | Applying a 38% SDF solution, with or without tannic acid, effectively stopped the progression of tooth decay. Tannic acid provided no additional advantage. When traditional methods of restoring primary teeth are not an option, ACT (Arresting caries treatment) with 38% SDF presents an alternative therapy. |
| Zhi *et al.* [39] | 2012 | RCT | 212 children, aged 3–4 yr | Grp 1: SDF every 12 mon<br>Grp 2: SDF every 6 mon<br>Grp 3: GIC every 12 mon | Primary dentition | GIC | Caries arrest rate at 24 mon | Taste or blackening of the arrested lesion | Arrest in the caries progression. The efficacy of yearly administration of GIC and SDF is equivalent. Applying SDF every 6 mon might enhance the rate of caries arrest compared to applying it annually. |
| Liu *et al.* [40] | 2012 | RCT | 501 children, Mean age of 9 yr | Grp 1: Resin sealant<br>Grp 2: Semi-annual application of 5% NaF varnish<br>Grp 3: Annual application of 38% SDF<br>Grp 4: placebo (annual application of water) | Permanent molars | Resin sealant, NaF varnish and placebo (water) | Caries Incidence (percentage) | Bitter taste was seen with SDF | All three techniques were efficacious in the prevention of pit and fissure caries in permanent molars. The success rate was almost same in all of the experimental groups, although there was a much decreased chance of carious cavity progression into dentin compared to the control group. |

**TABLE 1. Continued.**

| Author | Year | Study | Samples type | Study Design | Type of dentition | Comparison | Outcome assessment | Adverse events | Results |
|---|---|---|---|---|---|---|---|---|---|
| Monse *et al.* [50] | 2012 | NRCT | 704 children, 7–8 yr | Grp 1: SDF<br>Grp 2: ART glass ionomer cement<br>Grp 3: non treatment group | Permanent molars | ART Seal (Glass ionomer) | Caries increment | No adverse effects reported | The non-treatment group had a higher prevalence of caries. A singular application of 38% SDF is not an efficacious approach. |
| Shah *et al.* [44] | 2013 | RCT | 123 children of 6–9 yr | Grp 1: SDF<br>Grp 2: fluoride varnish<br>Grp 3: ApF Gel | Primary dentition, and permanent first molars | APF (1.23%) and Fluoride varnish (6% NaF, 6% $CaF_2$) | Mean S.*Mutans* count at 18 mon | No adverse effects reported | Decrease in S.Mutan populations caused by elevated fluoride levels and antibacterial properties. Due to its antibacterial activity, SDF may serve as a very effective fluoride agent. |
| Shah *et al.* [45] | 2014 | RCT | 123 children of 6–9 yr | Grp 1: SDF<br>Grp 2: fluoride varnish<br>Grp 3: ApF Gel | Primary dentition, and permanent first molars | APF (1.23%) and Fluoride varnish (6% NaF, 6% $CaF_2$) | APF and Fluoride varnish percentage Mean Fluoride Content at 6 mon | No adverse effects reported | Caries reduction was seen in all groups. After applying SDF to enamel, the fluoride level in the enamel is significantly increased. SDF was more effective in lowering the quantity of freshly formed carious surfaces. |
| Fung *et al.* [31] | 2018 | RCT | 888 children of 3 to 4 yr | Deciduous teeth<br>Grp 1: 12% SDF every 12 mon<br>Grp 2: 12% SDF every 6 mon<br>Grp 3: 38% SDF every 12 mon<br>Grp 4: 38% SDF every 6 mon | Primary dentition | 12% SDF | Percentage of arrested dentinal caries | SDF application resulted in black staining | Effectiveness is at 8% SDF The biannual administration of SDF is more efficacious than the yearly administration in both children and those with suboptimal dental hygiene. Enhancing the treatment frequency from an annual basis to a biannual basis would result in a higher incidence of caries arrest. |

**TABLE 1. Continued.**

| Author | Year | Study | Samples type | Study Design | Type of dentition | Comparison | Outcome assessment | Adverse events | Results |
|---|---|---|---|---|---|---|---|---|---|
| Tirupathi *et al.* [43] | 2019 | RCT | 159 active lesions in 50 children of 6–10 yr | Deciduous teeth Grp A: 5% NSSF Grp B: 38% SDF | Primary dentition | 5% NSSF (Nano silver incorporates sodium fluoride) | Mean Depth of lesions at the end of 12th month | No adverse events reported | The success rates were same between the two groups. The application of SDF resulted in the formation of persistent black stains that gradually disappeared within a period of 6 months. NSSF, on the other hand, demonstrated superior or equivalent efficacy compared to SDF at a concentration of at least 38%. NSSF did not result in the formation of black discoloration in contrast to SDF. |
| Mabangkhru *et al.* [51] | 2020 | RCT | 302 children 1–2 yr | Deciduous teeth Grp 1: 38% SDF Grp 2: 5% NaF | Primary dentition | 5% NaF | Arresting Dentin Caries | No systemic adverse events reported by parents or children | Based on the 12-mon results, 38% SDF is more effective than 5% NaF varnish in arresting dentin carious lesions in young children. SDF has no negative impact on parental satisfaction with the child's dental appearance. |
| Gao *et al.* [42] | 2020 | RCT | 1070 children 3 yr old children | Deciduous teeth Grp A: 25% AgNO3 and 5% NaF varnish Grp B: 38% SDF | Primary dentition | 25% Silver nitrate followed by 5% NaF varnish | Arresting of Caries (6, 12, 18, 24 and 30 mon follow up) | No adverse effects reported | Semi-annual application of 25% AgNO3 followed by 5% NaF is at least as effective as the semi-annual application of 38% SDF in arresting ECC. Silver and fluoride products are effective in arresting caries. As a simple, non-invasive, and inexpensive strategy, it can be used in young children, elderly adults, and people with special needs. |
| Abdellatif *et al.* [46] | 2023 | RCT | 1606 lesions in 220 children aged 3–4 yr | Grp 1: 38% SDF combined with 5% NaF varnish, Grp 2: 38% SDF | Primary dentition | 38% SDF alone | Arresting of Caries | Transient gum blanching observed in few children in SDF group | SDF + NaF had a higher arrest rate than SDF alone and this difference was significant in moderate but not advanced lesions. The findings have implications for the non-invasive management of ECC. |

**TABLE 1. Continued.**

| Author | Year | Study | Samples type | Study Design | Type of dentition | Comparison | Outcome assessment | Adverse events | Results |
|---|---|---|---|---|---|---|---|---|---|
| Yassin R *et al.* [47] | 2023 | RCT | 165 children with 949 active lesions aged <4 yr | Grp 1: 38% SDF solution Grp 2: 5% NaF varnish, both groups were provided with parental Motivational Interviewing on oral hygiene | Primary dentition | 2.5% NaF varnish | Arresting of Caries | No adverse events reported by caregivers at 24 h | At the end of 6 mon follow there were no significant differences between SDF and NaF/MI groups in overall caries arrest (63.7% and 58.1%, $p = 0.08$), and in moderate lesions (72.9% and 69.6%, $p = 0.52$). However, in advanced lesions, the arrest rate was significantly higher in the SDF than the NaF/MI group (60.3% and 50.0%, $p = 0.01$). NaF/MI can be an alternative to SDF in arresting advanced and moderate ECC lesions without staining with stronger effect on moderate lesions (ICDAS 3/4). |

*SDF: Silver diamine Fluoride; RCT: randomized clinical Trial; NRCT: non randomised clinical trial; NaF: Sodium Fluoride; ART: Atraumatic restorative technique; APF: Acidulate phosphate Fluoride; $CaF_2$: Calcium Fluoride; NSSF: Nano Silver incorporated sodium fluoride; ECC: Early childhood caries; ICDAS: International caries detection and assessment system; GIC: Glass ionomer cement.*

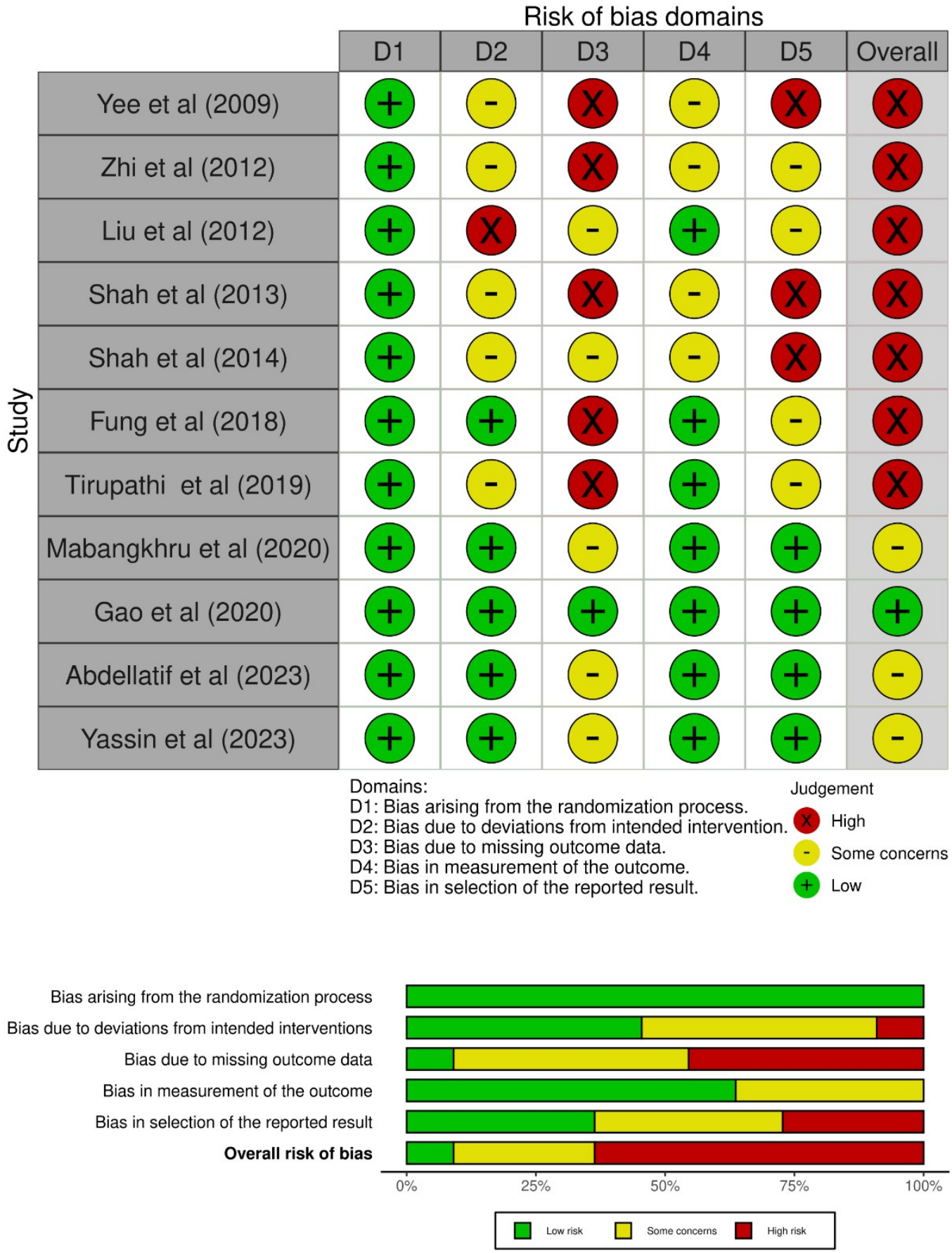


**FIGURE 2. Summary of risk of bias assessment using ROB2 for randomized controlled trials.**

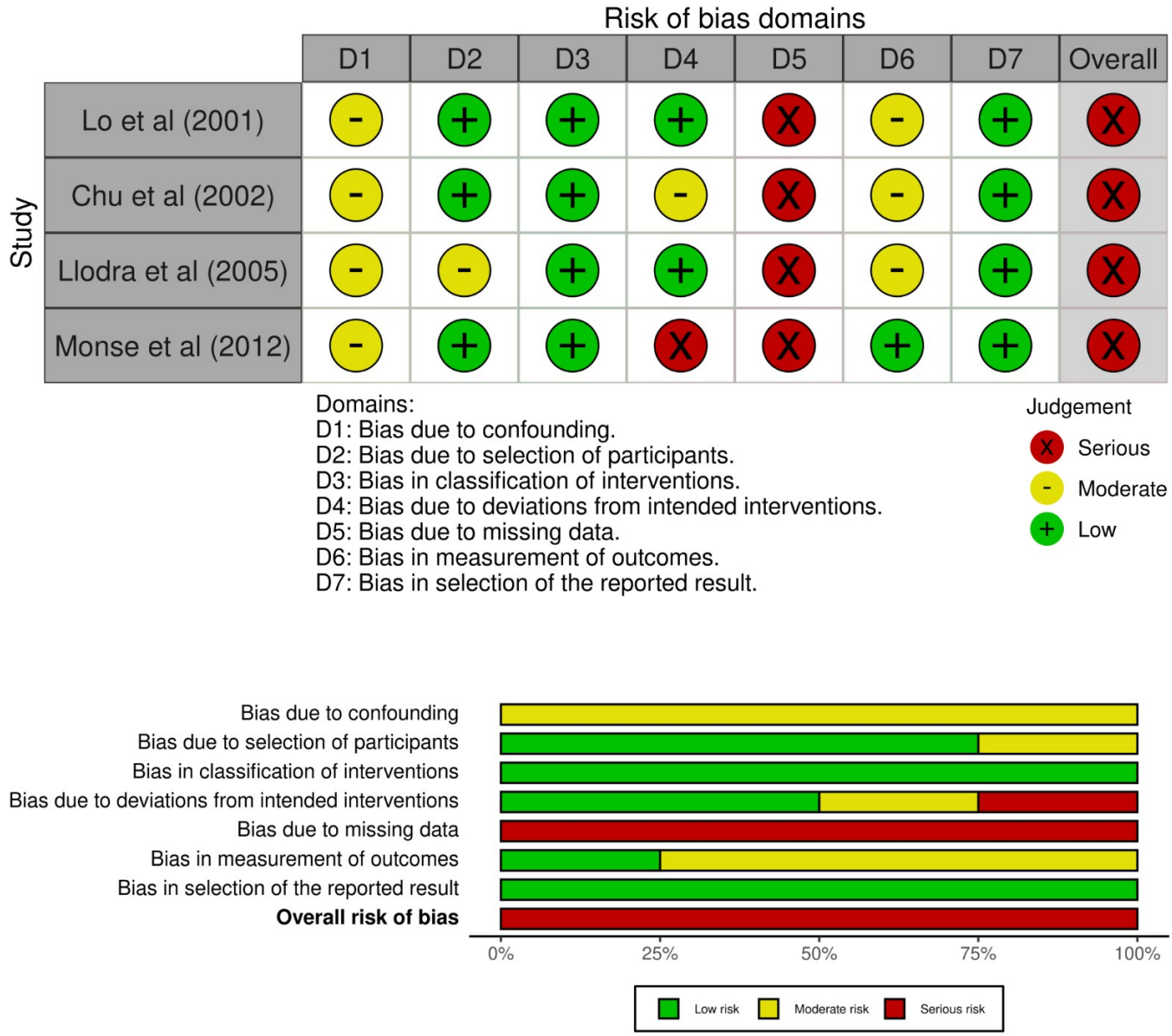


**FIGURE 3. Summary of risk of bias assessment using ROBINS-I for non-randomized studies.**

## 3.3 Comparison

Each of the studies included in the analysis was categorized into one of the three groups, namely studies conducted on children with primary dentition [31, 39, 41–43, 46–49, 51] (10 studies), children with primary dentition, and permanent first molars [38, 44, 45] (3 studies), and children with permanent molars (2 studies) [40, 50].

The comparators used in the studies varied widely among studies, consisting mainly of topical fluoride varnishes, Glass Ionomer Cement (GIC), placebos and different concentrations of SDF. Unfortunately, the SDF concentration details are inconsistently reported in the studies listed in Table 1 of the manuscript. Two studies used placebo [40, 49] or while two studies control groups had no treatment [38, 50]. Seven studies used topical fluorides in the form of acidulated phosphate fluoride [44, 45], sodium fluoride [38, 40, 41, 47, 51], nanosilver incorporated fluoride [43]. Two studies used GIC [39, 50], one study used different concentrations of SDF applied at different time periods [31], Silver nitrate and sodium fluoride. were used in one study [49] and another study used SDF combined with sodium fluoride [46].

## 3.4 Effects of intervention

Silver diamine fluoride (SDF) was seen to effectively arrest caries. Of the fifteen studies considered in this review, eleven studies found that SDF successfully arrested caries progression [31, 38–41, 44–46, 48, 49, 51]. SDF was as effective as Nano-silver incorporated Sodium fluoride (NSSF) [43], GIC Resin sealant [39] and sodium fluoride varnish [40]. Contrarily, one clinical trial reported that single-time application of 38% SDF was not completely effective in protecting the subjects from the onset of new dental caries [47]. Two studies compared the potency of 38% SDF with sodium fluoride varnish and Acidulated Phosphate Fluoride (APF) gel in preventing dental caries. SDF had a significant increase in the fluoride levels in the enamel in comparison to fluoride varnish and APF gel during

the 6-month follow-up ($p < 0.001$) [45]. Extensive application of SDF notably reduced the *Streptococcus mutans* count in the saliva compared to fluoride varnish and APF gel, at 18 months of follow-up ($p < 0.001$) [44]. An annual application of SDF solution was more effective in preventing dental caries in primary anterior teeth among pre-school children ($p < 0.001$), whereas children in the sodium fluoride group had a higher risk of developing carious lesions [41]. An annual application of SDF was as effective as a resin sealant and sodium fluoride varnish (semi-annual application) in arresting pit and fissure caries in permanent molars [40]. Children regularly receiving SDF applications every year benefited from higher arrest rates of caries lesions in the upper anterior teeth compared to the sodium fluoride group ($p < 0.001$) [38].

Semi-annual application of Silver nitrate followed by sodium varnish showed the same effect as a semiannual application of SDF [42] and SDF combined with sodium fluoride showed a higher arrest rate when compared to SDF alone [46]. Studies comparing the effectiveness of the annual application of SDF against GIC showed no startling difference in preventing the growth of active dental caries in primary teeth [39, 50]. Applying an SDF solution twice every year stimulates a better arrest rate of dental caries, proving to be a better alternative [39]. Using an atraumatic restorative treatment (ART) sealant offered better resistance in arresting new dentinal caries compared to a one-time application of 38% SDF solution on the occlusal surfaces of the permanent first molars among children aged 6–8 years [50]. 5% NSSF appeared to be as efficacious as an annual application of SDF during a 12-month follow-up period [43]. Comparing different concentrations of SDF showed that 38% SDF was better efficient in treating carious lesions compared to 12% SDF, at the end of 30 months [31].

Despite the gradual decline of effectiveness rate through the 24-month trial, the one-time application of 38% SDF on both anterior and posterior primary teeth was more effective in arresting caries lesions compared to the 12% SDF application that was altogether ineffective [48]. There were several adverse effects reported in the included studies, the most common of which was black staining/discoloration in the arrested dental caries [31, 38, 39, 41, 43, 46–49, 51]. There was one study that reported mild painful white lesions in the oral mucosa [46]. Four studies did not mention any adverse effects [42, 44, 45, 50].

## 4. Discussion

Early childhood caries is a preventable chronic disease that affects children across the globe. It remains a concern in industrialized and developing countries where access to healthcare may be limited or unaffordable [54]. The application of fluorides may serve to not just prevent caries but also reduce the caries prevalence and arrest the progression of carious lesions. This review examined the evidence for the effectiveness of silver diamine fluoride (SDF) in arresting caries in children. Fifteen articles are included in this review, of which three were non-randomized controlled trials and eight were randomized controlled trials. An annual application of 38% silver diamine fluoride appears to arrest caries coronal and dentine caries in children. Most of the articles found SDF to be as efficacious as fluoride varnishes, nanosilver incorporated sodium fluoride, GIC, and resin sealant in arresting caries [31, 38–41, 45, 48, 49]. However, SDF may not protect from the onset of new dental caries [50]. From the present analysis, 38% SDF solutions appeared superior when compared to other interventions studied. Further, a relatively larger surface area with inactive caries was observed in children who underwent SDF treatment. Recommended regimens for its application were one-time, semi-annual and yearly. SDF penetrates the enamel and dentine and shows evidence of higher fluoride retention compared to varnishes [55]. Its action protects collagen from degradation and prevents demineralization through the formation of resistant fluorapatite [56]. The silver ions prevent biofilm formation and are bactericidal. Taken together, this multipronged approach to halting caries progression contributes to the efficacy of SDF [57]. In contrast to this multifaceted approach, varnishes have a single approach to reduce caries through remineralization. Niederman *et al.* [58] reported that SDF was better tolerated, simpler and more affordable when compared to sealants.

Most of the studies were conducted in China and India, presumably due to the higher prevalence of childhood dental caries recorded in these countries [59, 60]. SDF may be excellent to use in developing countries due to its ease of application, low infrastructure needs, and few side effects. SDF is a cost-effective caries-control agent that is minimally invasive and can be used in children who may not tolerate conventional dental treatment. The most common side effect reported in most of the studies was the presence of black staining or discoloration in the arrested dental caries [31, 38–41, 48, 49, 59]. These results reflect those of Mei *et al.* [61] who reported black dental stains that appear after SDF application. The inconvenience of staining associated with SDF can be mitigated through the incorporation of various products [62]. Recent evidence suggests that the addition of potassium iodide to the SDF solution may mitigate tooth discoloration [55, 56]. The black discoloration may be a layer of sclerotic dentin that helps arrest future carious lesion development. Carious dentin and enamel may turn dark brown. One study reported the formation of a painful white lesion on the mucosa after SDF application [49]. This is consistent with previous rare reports of mucosal and soft tissue irritation with SDF [29, 63]. However, these changes are believed to be transient. Several reviews have examined the effectiveness of SDF in slowing caries progression. Applying a solution of 38% SDF produced similar results across age groups in children [64], adolescents and the elderly [65]. This agrees with the findings of our review. Chibinski *et al.* [57] found that SDF was 89% more effective at arresting caries than other treatments. This accords with earlier observations by Trieu *et al.* [66] that SDF was statistically more effective in arresting dentine caries compared to sodium fluoride. Consistent with previous literature [67–69], the findings of this review support that SDF has a positive effect on arresting and slowing the progression of carious lesions, outperforming fluoride varnishes, atraumatic restorations and placebos. This review differs from earlier reviews in that it examined the effectiveness of silver diamine fluoride on early childhood caries in a population of children.

This review summarizes evidence that can help clinicians to make the best concentration and fluoride product to arrest caries. The findings of this review can help shape public health policy in dealing with early childhood caries.

### 4.1 Completeness and applicability of evidence

In this review, the assessment focused on the evidence for arresting caries in primary and permanent teeth of children through the application of silver diamine fluoride. Examining fifteen studies published between 2001 and 2023 revealed that the majority supported the utilization of silver diamine fluoride as a minimally invasive technique. The sample sizes were large enough, providing confidence to the evidence. A majority of the studies are older than a decade, indicating the paucity of recent well-designed large-scale randomized trials. Heterogeneity in the study designs and concentrations precluded a meta-analysis. Most studies used conventional visual and tactile methods to diagnose caries. Future studies could use laser fluorescence or DIAGNOdent devices to detect and sensitively assess the extent of caries. Future studies should match the baseline level of caries and examine other sources of fluoride exposure such as drinking water, milk, denitrifiers, supplements, *etc*. as the frequency of application of SDF solution (applied every six months compared to annually) could contribute to the magnitude of the effect *i.e.*, an increase in caries arrest.

Most of the studies reported adverse effects that were linked to the use of SDF, the most common report being black stains or discoloration of teeth [31, 38, 39, 41, 43, 46–49, 51]. Adverse effects are an important consideration that can determine whether a treatment modality is accepted by a patient. Concerns regarding the staining of permanent teeth need to be addressed in future studies examining the ideal concentration of SDF for arresting caries. Communication between dental care providers, patients and parents is crucial to address the aesthetic concerns linked to SDF to manage expectations and optimize dental health.

### 4.2 Quality of evidence

While a few studies in this systematic review exhibited low risk, concerns about bias in certain domains necessitate a cautious interpretation of the results regarding the effectiveness of SDF in arresting coronal dental caries in children and adolescents. Though most studies in this review consistently suggest that silver diamine fluoride is effective in arresting early childhood caries, pre-intervention prognostic factors such as the severity of caries could result in baseline confounding. Studies reported participants dropping out during the trials. These factors affect the confidence of the outcomes, underscoring the need for methodologically robust studies to ensure reliable conclusions.

### 4.3 Limitations & strengths

After an extensive search, only a limited number of clinical trials were found that investigated the formation of new dental caries lesions as an outcome measure. Most of the studies concentrated on exploring the potential of SDF for the arrest of dental caries and the prevention of further progression. Therefore, there is a need for new trials specifically designed to explore the application of SDF on tooth surfaces regardless of their caries status. To maintain consistency in reporting and reduce deficiencies in result dissemination, the assessment of bias risk was conducted using RoB2 and ROBINS-I, providing strength to this systematic review. However, it is essential to emphasize that a high risk of bias was identified in all the studies, encompassing both randomized and non-randomized trials. Consequently, the discussion and conclusions should carefully consider this aspect. And, it is important to note that the conclusions drawn from this review may be subject to change as new evidence becomes available. Additionally, this review only included articles published in English, so studies published in other languages were not considered. Despite these limitations, the assertion remains that this review offers the most comprehensive summary of the available evidence on this topic.

## 5. Conclusions

Based on limited available evidence, silver diamine fluoride appears to arrest caries in primary and permanent teeth in children and adolescents. At concentrations of 38%, SDF can serve as a viable treatment option in arresting caries in a community setting. There are concerns regarding black stains and discoloration linked to the use of SDF which may affect aesthetic acceptability. Future studies should examine the time taken to arrest the progression of carious lesions and the frequency of application to provide a fuller picture of the management of early childhood caries with silver diamine fluoride. Further research is necessary before universal guidelines for clinical use can be established.

### ABBREVIATIONS

SDF, Silver diamine fluoride; ECC, Early Childhood Caries; FDA, Food and Drug Administration; RoB2, Risk of Bias 2; ROBINS-I, Risk of Bias In Non-randomised Studies of Interventions; GIC, Glass Ionomer Cement; NSSF, Nano-silver incorporated Sodium fluoride; APF, Acidulated Phosphate Fluoride; ART, Atraumatic Restorative Treatment; $CaF_2$, Calcium Fluoride; ICDAS, International caries detection and assessment system.

### AVAILABILITY OF DATA AND MATERIALS

Not applicable.

### AUTHOR CONTRIBUTIONS

SV, PCM and AAS—carried out conceptualization. PCM, GJ, AK and SP—develop methodology. SV, GJ, AHHJ, ZK and AR—conduct formal analysis. PCM, AK, AAS, DHA, ZK, HAB and AR—handle data interpretation. SV, GJ, AJ, DHA, HAB and SP—perform acquisition of data. SV, PCM, GJ, AK, AAS and AHHJ—the original draft preparation. DHA, ZK, SP,

HAB and AR—conduct the final step of review and editing.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

## ACKNOWLEDGMENT

Not applicable.

## FUNDING

This research received no external funding.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## REFERENCES

[1] Kinane DF, Stathopoulou PG, Papapanou PN. Periodontal diseases. Nature Reviews Disease Primers. 2017; 3: 17038.

[2] McGrath C, Broder H, Wilson-Genderson M. Assessing the impact of oral health on the life quality of children: implications for research and practice. Community Dentistry and Oral Epidemiology. 2004; 32: 81–85.

[3] Feitosa S, Colares V, Pinkham J. The psychosocial effects of severe caries in 4-year-old children in Recife, Pernambuco, Brazil. Cad Saude Publication. 2005; 21: 1550–1556.

[4] Singh N, Dubey N, Rathore M, Pandey P. Impact of early childhood caries on quality of life: child and parent perspectives. Journal of Oral Biology and Craniofacial Research. 2020; 10: 83–86.

[5] Filstrup SL, Briskie D, da Fonseca M, Lawrence L, Wandera A, Inglehart MR. Early childhood caries and quality of life: child and parent perspectives. Pediatric Dentistry. 2003; 25: 431–440.

[6] Martins-Júnior PA, Vieira-Andrade RG, Corrêa-Faria P, Oliveira-Ferreira F, Marques LS, Ramos-Jorge ML. Impact of early childhood caries on the oral health-related quality of life of preschool children and their parents. Caries Research. 2013; 47: 211–218.

[7] Teng AYT, Liang CY, Liu YCG. Socio-economic status may associate different risk(s) with early childhood caries (ECC) that can cause the development of psychomotor deficiency in preschool children aged 3–6 years old: the results of preliminary analysis from a cohort study. International Journal of Environmental Research and Public Health. 2021; 18: 9011.

[8] Zaror C, Matamala-Santander A, Ferrer M, Rivera-Mendoza F, Espinoza-Espinoza G, Martínez-Zapata MJ. Impact of early childhood caries on oral health-related quality of life: a systematic review and meta-analysis. International Journal of Dental Hygiene. 2022; 20: 120–135.

[9] Uribe SE, Innes N, Maldupa I. The global prevalence of early childhood caries: a systematic review with meta-analysis using the who diagnostic criteria. International Journal of Paediatric Dentistry. 2021; 31: 817–830.

[10] Kazeminia M, Abdi A, Shohaimi S, Jalali R, Vaisi-Raygani A, Salari N, *et al*. Dental caries in primary and permanent teeth in children's worldwide, 1995 to 2019: a systematic review and meta-analysis. Head & Face Medicine. 2020; 16: 22.

[11] Phantumvanit P, Makino Y, Ogawa H, Rugg-Gunn A, Moynihan P, Petersen PE, *et al*. Who global consultation on public health intervention against early childhood caries. Community Dentistry and Oral Epidemiology. 2018; 46: 280–287.

[12] Tinanoff N, Baez RJ, Diaz Guillory C, Donly KJ, Feldens CA, McGrath C, *et al*. Early childhood caries epidemiology, aetiology, risk assessment, societal burden, management, education, and policy: global perspective. International Journal of Paediatric Dentistry. 2019; 29: 238–248.

[13] Pierce A, Singh S, Lee J, Grant C, Cruz de Jesus V, Schroth RJ. The burden of early childhood caries in Canadian children and associated risk factors. Frontiers in Public Health. 2019; 7: 328.

[14] Colak H, Dülgergil CT, Dalli M, Hamidi MM. Early childhood caries update: a review of causes, diagnoses, and treatments. Journal of Natural Science, Biology and Medicine. 2013; 4: 29–38.

[15] Poureslami HR, Van Amerongen WE. Early childhood caries (ECC): an infectious transmissible oral disease. The Indian Journal of Pediatrics. 2009; 76: 191–194.

[16] Schwendicke F. Contemporary concepts in carious tissue removal: a review. Journal of Esthetic and Restorative Dentistry. 2017; 29: 403–408.

[17] Johansen E, Olsen TO. Topical fluorides in the prevention and arrest of dental caries. In Johansen E, Olsen TO (eds.) Continuing evaluation of the use of fluorides (pp. 61–110). 1st edn. CRC Press: Boca Raton. 2019.

[18] Baik A, Alamoudi N, El-Housseiny A, Altuwirqi A. Fluoride varnishes for preventing occlusal dental caries: a review. Journal of Dentistry. 2021; 9: 64.

[19] Zhao IS, Gao SS, Hiraishi N, Burrow MF, Duangthip D, Mei ML, *et al*. Mechanisms of silver diamine fluoride on arresting caries: a literature review. International Dental Journal. 2018; 68: 67–76.

[20] Thibodeau EA, Handelman SL, Marquis RE. Inhibition and killing of oral bacteria by silver ions generated with low intensity direct current. Journal of Dental Research. 1978; 57: 922–926.

[21] dos Santos VE, Filho AV, Ribeiro Targino AG, Pelagio Flores MA, Galembeck A, Caldas AF, *et al*. A new "Silver-Bullet" to treat caries in children—nano silver fluoride: a randomised clinical trial. Journal of Dentistry. 2014; 42: 945–951.

[22] Suzuki T, Nishida M, Sobue S, Moriwaki Y. Effects of diammine silver fluoride on tooth enamel. The Journal of Osaka University Dental School. 1974; 14: 61–72.

[23] Wu MY, Suryanarayanan K, van Ooij WJ, Oerther DB. Using microbial genomics to evaluate the effectiveness of silver to prevent biofilm formation. Water Science and Technology. 2007; 55: 413–419.

[24] Horst JA, Ellenikiotis H, Milgrom PL. UCSF protocol for caries arrest using silver diamine fluoride: rationale, indications and consent. Journal of the California Dental Association. 2016; 44: 16–28.

[25] Nishino M, Yoshida S, Sobue S, Kato J, Nishida M. Effect of topically applied ammoniacal silver fluoride on dental caries in children. The Journal of Osaka University Dental School. 1969; 9: 149–155.

[26] Wilson J, Swanbeck S, Banning G, Alhwayek T, Sullivan V, Howard KM, *et al.* Assessment of sodium diamine fluoride (SDF) with light curing technique: a pilot study of antimicrobial effects. Methods and Protocols. 2022; 5: 31.

[27] Li R, Lo ECM, Liu BY, Wong MCM, Chu CH. Randomized clinical trial on arresting dental root caries through silver diammine fluoride applications in community-dwelling elders. Journal of Dentistry. 2016; 51: 15–20.

[28] Whiting P, Savović J, Higgins JPT, Caldwell DM, Reeves BC, Shea B, *et al*. ROBIS: a new tool to assess risk of bias in systematic reviews was developed. Journal of Clinical Epidemiology. 2016; 69: 225–234.

[29] Mei ML, Li Q, Chu C, Lo E, Samaranayake LP. Antibacterial effects of silver diamine fluoride on multi-species cariogenic biofilm on caries. Annals of Clinical Microbiology and Antimicrobials. 2013; 12: 4.

[30] Milgrom P, Horst JA, Ludwig S, Rothen M, Chaffee BW, Lyalina S, *et al*. Topical silver diamine fluoride for dental caries arrest in preschool children: a randomized controlled trial and microbiological analysis of caries associated microbes and resistance gene expression. Journal of Dentistry. 2018; 68: 72–78.

[31] Fung MHT, Duangthip D, Wong MCM, Lo ECM, Chu CH. Randomized clinical trial of 12% and 38% silver diamine fluoride treatment. Journal of Dental Research. 2018; 97: 171–178.

[32] Brignardello-Petersen R. 37% silver diamine fluoride is more effective than 12% silver diamine fluoride in arresting caries in the primary dentition. The Journal of the American Dental Association. 2017; 148: e205.

[33] Duangthip D, Chu CH, Lo ECM. A randomized clinical trial on arresting dentine caries in preschool children by topical fluorides—18 month results. Journal of Dentistry. 2016; 44: 57–63.

[34] Devji T. Silver diamine fluoride is probably more effective than atraumatic restorative treatment, fluoride varnish, or no treatment for

controlling caries progression in children. The Journal of the American Dental Association. 2018; 149: e65.
[35] Tolba ZO, Hamza HS, Moheb DM, Hassanein HE, El Sayed HM. Effectiveness of two concentrations 12% versus 38% of silver diamine fluoride in arresting cavitated dentin caries among children: a systematic review. Egyptian Pediatric Association Gazette. 2019; 67: 1–7.
[36] Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, *et al*. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. British Medical Journal. 2021; 372: n71.
[37] Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, *et al*. Cochrane handbook for systematic reviews of interventions. 2nd edn. John Wiley & Sons: Chichester. 2019.
[38] Chu CH, Lo ECM, Lin HC. Effectiveness of silver diamine fluoride and sodium fluoride varnish in arresting dentin caries in Chinese pre-school children. Journal of Dental Research. 2002; 81: 767–770.
[39] Zhi QH, Lo ECM, Lin HC. Randomized clinical trial on effectiveness of silver diamine fluoride and glass ionomer in arresting dentine caries in preschool children. Journal of Dentistry. 2012; 40: 962–967.
[40] Liu BY, Lo ECM, Chu CH, Lin HC. Randomized trial on fluorides and sealants for fissure caries prevention. Journal of Dental Research. 2012; 91: 753–758.
[41] Lo EC, Chu CH, Lin HC. A Community-based caries control program for pre-school children using topical fluorides: 18-month results. Journal of Dental Research. 2001; 80: 2071–2074.
[42] Gao SS, Chen KJ, Duangthip D, Wong MCM, Lo ECM, Chu CH. Arresting early childhood caries using silver and fluoride products—a randomised trial. Journal of Dentistry. 2020; 103: 103522.
[43] Tirupathi S, Svsg N, Rajasekhar S, Nuvvula S. Comparative cariostatic efficacy of a novel nano-silver fluoride varnish with 38% silver diamine fluoride varnish a double-blind randomized clinical trial. Journal of Clinical and Experimental Dentistry. 2019; 11: e105–e112.
[44] Shah S, Bhaskar V, Venkataraghavan K, Choudhary P, Ganesh M, Trivedi K. Efficacy of silver diamine fluoride as an antibacterial as well as antiplaque agent compared to fluoride varnish and acidulated phosphate fluoride gel: an *in vivo* study. Indian Journal of Dental Research. 2013; 24: 575–581.
[45] Shah S, Bhaskar V, Chawla S, Venkataraghavan K, Choudhary P, Ganesh M, *et al*. Efficacy of silver diamine fluoride as a topical fluoride agent compared to fluoride varnish and acidulated phosphate fluoride gel: an *in vivo* study. Journal of Pediatric Dentistry. 2014; 2: 5–12.
[46] Abdellatif EB, El Kashlan MK, El Tantawi M. Silver diamine fluoride with sodium fluoride varnish versus silver diamine fluoride in arresting early childhood caries: a 6-months follow up of a randomized field trial. BMC Oral Health. 2023; 23: 875.
[47] Yassin R, Amer H, Tantawi ME. Effectiveness of silver diamine fluoride versus sodium fluoride varnish combined with mother's motivational interviewing for arresting early childhood caries: a randomized clinical trial. BMC Oral Health. 2023; 23: 710.
[48] Yee R, Holmgren C, Mulder J, Lama D, Walker D, van Palenstein Helderman W. Efficacy of silver diamine fluoride for arresting caries treatment. Journal of Dental Research. 2009; 88: 644–647.
[49] Llodra JC, Rodriguez A, Ferrer B, Menardia V, Ramos T, Morato M. Efficacy of silver diamine fluoride for caries reduction in primary teeth and first permanent molars of schoolchildren: 36-month clinical trial. Journal of Dental Research. 2005; 84: 721–724.
[50] Monse B, Heinrich-Weltzien R, Mulder J, Holmgren C, van Palenstein Helderman WH. Caries preventive efficacy of silver diammine fluoride (SDF) and ART sealants in a school-based daily fluoride toothbrushing program in the Philippines. BMC Oral Health. 2012; 12: 52.
[51] Mabangkhru S, Duangthip D, Chu CH, Phonghanyudh A, Jirarattanasopha V. A randomized clinical trial to arrest dentin caries in young children using silver diamine fluoride. Journal of Dentistry. 2020; 99: 103375.
[52] Yang ZR, Sun F, Zhan SY. Risk on bias assessment: (2) revised Cochrane risk of bias tool for individually randomized, parallel group trials (RoB2.0). Chinese Journal of Epidemiology. 2017; 38: 1285–1291. (In Chinese)
[53] Sterne JA, Hernán MA, Reeves BC, Savović J, Berkman ND, Viswanathan M, *et al*. ROBINS-I: a tool for assessing risk of bias in non-randomised studies of interventions. The BMJ. 2016; 355: i4919.
[54] Mouradian WE, Wehr E, Crall JJ. Disparities in children's oral health and access to dental care. JAMA. 2000; 284: 2625–2631.
[55] Kamble AN, Chimata VK, Katge FA, Nanavati KK, Shetty SK. Comparative evaluation of effect of potassium iodide and glutathione on tooth discoloration after application of 38% silver diamine fluoride in primary molars: an *in vitro* study. International Journal of Clinical Pediatric Dentistry. 2021; 14: 752–756.
[56] Detsomboonrat P, Thongmak P, Lertpayab P, Aiemsri W, Sooampon S. Optimal concentration of potassium iodide to reduce the black staining of silver diamine fluoride. Journal of Dental Sciences. 2022; 17: 300–307.
[57] Chibinski AC, Wambier LM, Feltrin J, Loguercio AD, Wambier DS, Reis A. Silver diamine fluoride has efficacy in controlling caries progression in primary teeth: a systematic review and meta-analysis. Caries Research. 2017; 51: 527–541.
[58] Niederman R, Huang SS, Trescher A, Listl S. Getting the incentives right: improving oral health equity with universal school-based caries prevention. American Journal of Public Health. 2017; 107: S50–S55.
[59] Ganesh A, Muthu MS, Mohan A, Kirubakaran R. Prevalence of early childhood caries in India—a systematic review. The Indian Journal of Pediatrics. 2019; 86: 276–286.
[60] Zhang X, Yang S, Liao Z, Xu L, Li C, Zeng H, *et al*. Prevalence and care index of early childhood caries in mainland China: evidence from epidemiological surveys during 1987–2013. Scientific Reports. 2016; 6: 18897.
[61] Mei ML, Lo ECM, Chu CH. Arresting dentine caries with silver diamine fluoride: what's behind it? Journal of Dental Research. 2018; 97: 751–758.
[62] Asghar M, Omar RA, Yahya R, Yap AU, Shaikh MS. Approaches to minimize tooth staining associated with silver diamine fluoride: a systematic review. Journal of Esthetic and Restorative Dentistry. 2023; 35: 322–332.
[63] Crystal YO, Niederman R. Evidence-based dentistry update on silver diamine fluoride. Dental Clinics of North America. 2019; 63: 45–68.
[64] Contreras V, Toro MJ, Elías-Boneta AR, Encarnación-Burgos A. Effectiveness of silver diamine fluoride in caries prevention and arrest: a systematic literature review. General Dentistry. 2017; 65: 22–29.
[65] Hendre AD, Taylor GW, Chávez EM, Hyde S. A systematic review of silver diamine fluoride: effectiveness and application in older adults. Gerodontology. 2017; 34: 411–419.
[66] Trieu A, Mohamed A, Lynch E. Silver diamine fluoride versus sodium fluoride for arresting dentine caries in children: a systematic review and meta-analysis. Scientific Reports.2019; 9: 2115.
[67] Seifo N, Al-yaseen W, Innes N. The efficacy of silver diamine fluoride in arresting caries in children. Evidence-Based Dentistry. 2018; 19: 42–43.
[68] Bhojraj N, Shanbhog R, Singhania S. Is silver diamine fluoride really a magic alternative in pediatric caries management? World Journal of Dentistry. 2021; 12: 350–354.
[69] Wajahat M, Abbas B, Tariq K, Imran E, Aslam S, Khurshid Z. Parental perception of silver diamine fluoride for the management of dental caries. Journal of Taibah University Medical Sciences. 2022; 17: 408–414.

**How to cite this article:** Satish Vishwanathaiah, Prabhadevi C Maganur, Ather Ahmed Syed, Ateet Kakti, Atlal Hassan Hussain Jaafari, Dhalia H Albar, *et al*. Effectiveness of silver diamine fluoride (SDF) in arresting coronal dental caries in children and adolescents: a systematic review. Journal of Clinical Pediatric Dentistry. 2024; 48(5): 27-40. doi: 10.22514/jocpd.2024.101.