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REVIEWARTICALE

SILVER DIAMINE FLUORIDE IN DENTISTRY: A SYSTEMATIC REVIEW AND META ANALYSIS

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ABSTRACT

Background: Dental caries remains one of the most prevalent chronic diseases worldwide, affecting both primary and permanent dentitions. Silver diamine fluoride (SDF) has emerged *as a non-invasive, cost-effective, and efficient agent for caries arrest and prevention.*

Objective: To systematically review and synthesize current evidence on the clinical efficacy, safety, and practical applications of SDF in both pediatric and adult populations.

Materials and Methods:A systematic review was conducted following PRISMA guidelines. Electronic databases including PubMed, Scopus, Web of Science, Cochrane Library, and Google Scholar were searched up to October 2025. Inclusion criteria encompassed randomized controlled trials, clinical studies, systematic reviews, and in-vitro studies evaluating SDF in humans. Data extraction included study characteristics, population, SDF concentration, outcomes, and adverse effects. Quality assessment was performed using the Cochrane Risk of Bias tool, ROBINS-I, and AMSTAR 2. Quantitative synthesis was performed on 18 studies using meta-analysis to evaluate caries arrest efficacy.

Results: Thirty studies were included in qualitative synthesis, with 18 qualifying for meta-analysis. SDF demonstrated consistent caries-arresting efficacy across primary and permanent teeth, with odds ratios ranging from 2.80 to 3.80 for caries arrest compared to controls. Biannual application and use in pediatric populations yielded particularly high success rates. Laboratory and adjunctive studies confirmed chemical stability, antimicrobial properties, and minimal adverse effects, with tooth discoloration being the main esthetic concern, mitigated by potassium iodide or glutathione. Risk of bias assessment showed 18 studies with low risk, 8 with some concerns, and 4 with high risk.

Conclusion:SDF is a highly effective, safe, and non-invasive intervention for the prevention and arrest of dental caries. Its ease of application, low cost, and suitability for high-risk populations make it a valuable tool in both clinical and community dental settings.

Keywords*:*Caries arrest, fluoride therapy, non-invasive treatment, meta-analysis, pediatric dentistry, SDF

INTRODUCTION

Dental caries remains one of the most prevalent chronic diseases affecting populations worldwide, impacting both primary and permanent dentitions.[1–30]Despite advances in preventive dentistry and minimally invasive restorative techniques, untreated dental caries continues to pose a significant public health challenge, particularly in children, the elderly, and socioeconomically disadvantaged groups.[1–5,7–10,12,14,18] Conventional restorative approaches often require clinical infrastructure, patient cooperation, and financial resources that are not universally accessible. [9,10,11,13,15]

Silver diamine fluoride (SDF), a colorless alkaline solution containing silver and fluoride ions, has emerged as a non-invasive, cost-effective, and efficient agent for arresting dental caries. [1–3,6–8,12–14,16,19]

The dual mechanism of action—antimicrobial effects of silver ions and remineralizing potential of fluoride—makes SDF particularly valuable for community-based preventive programs and for patients with special healthcare needs. [5,6,7,11,21,22]

Originally developed in Japan in the 1960s, SDF has gained renewed attention globally due to its efficacy in caries arrest, ease of application, and suitability for atraumatic treatment protocols. [4,18,19,20]. It is used as a 38% solution (approximately 44,800 ppm fluoride and 253,900 ppm silver), which has been proven to

inactivate cariogenic bacteria such as *Streptococcus mutans* and *Actinomycesnaeslundii*, while promoting dentin hardening. [13,21,22] Recent evidence also supports its adjunctive use with potassium iodide (KI) and glass ionomer cement to minimize discoloration and enhance esthetics. [16,24–27]

Given the growing body of evidence on the clinical effectiveness, safety, and practical advantages of SDF, a systematic synthesis of the literature is essential to understand its current role and potential in dental practice. This review aims to consolidate and critically evaluate the available studies on the use of SDF in dentistry, focusing on its effectiveness, stability, antimicrobial properties, caries arrest potential, aesthetic implications, and clinical applicability in both pediatric and adult populations. [1–30]

MATERIALS AND METHODS

Study Design

This research was conducted as a systematic review following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The review aimed to compile and analyze published evidence on the use of silver diamine fluoride (SDF) for the prevention and management of dental caries.

Information Sources and Search Strategy

A comprehensive electronic search was performed across databases including PubMed, Scopus, Web of Science, Cochrane Library, and Google Scholar for articles published up to October 2025. The search was conducted using the following key terms and Boolean operators:

"Silver diamine fluoride" OR "SDF" AND ("dental caries" OR "caries arrest" OR "tooth decay" OR "pediatric dentistry" OR "fluoride therapy") AND ("systematic review" OR "clinical trial" OR "meta-analysis"). Reference lists of relevant articles and reviews were also manually screened to identify additional eligible studies.

Eligibility Criteria

Studies were included based on the following inclusion and exclusion criteria:

Inclusion Criteria

- Studies involving human subjects (children, adolescents, or adults).
- Systematic reviews, meta-analyses, randomized controlled trials, and in-vitro studies assessing SDF use in dentistry.
- Articles published in English.
- Studies reporting on caries prevention, arrest, antimicrobial effects, or material interaction with SDF.

Exclusion Criteria

- Case reports, letters, editorials, and non-peer-reviewed articles.
- Studies not involving SDF as a primary intervention.
- Animal studies or those lacking measurable outcomes related to caries management.

Study Selection Process

Two independent reviewers screened titles and abstracts for relevance. Full-text articles meeting the inclusion criteria were retrieved and assessed. Discrepancies in study selection were resolved through discussion and consensus.

Data Extraction

Data were extracted using a standardized form, including the following variables:

- Author(s) and year of publication
- Study design and sample size
- Type and concentration of SDF used
- Population characteristics (age group, dentition type)
- Outcome measures (caries arrest rate, discoloration, antimicrobial activity, bond strength)
- Follow-up duration and main findings

Quality Assessment

The methodological quality of included studies was appraised using the following tools:

- Cochrane Risk of Bias Tool for randomized controlled trials
- AMSTAR 2 (A Measurement Tool to Assess Systematic Reviews) for systematic reviews and meta-analyses
- Joanna Briggs Institute (JBI) checklist for observational and in-vitro studies

Data Synthesis

Findings were synthesized descriptively due to heterogeneity in study designs, populations, and outcome measures. Quantitative data from meta-analyses were reported as odds ratios (ORs) or risk ratios (RRs) with 95% confidence intervals where applicable. A PRISMA flow diagram was constructed to illustrate the selection process (Table 1).

Table 1.Silver Diamine Fluoride in Non-Operative Management of Dental Caries in Primary Teeth" (Medicina,

PICO Element	Description
Population (P)	Children with primary teeth affected by active dental caries (non-cavitated and cavitated lesions).
Intervention (I)	Application of 38% Silver Diamine Fluoride (SDF) as a non-operative caries management strategy.
Comparison (C)	Conventional restorative treatments (e.g., glass ionomer cement, composite resin, atraumatic restorative technique) or no treatment/placebo.
Outcome (O)	Caries arrest rate, lesion progression, esthetic acceptability, and adverse effects (such as tooth discoloration or soft-tissue irritation).
Study Design	Systematic Review of randomized controlled trials (RCTs) and clinical studies published in indexed journals.
Main Findings	SDF demonstrated high efficacy in arresting dental caries in primary teeth, particularly in low-resource or non-operative settings. Tooth discoloration was the most commonly reported drawback.
Conclusion	The use of SDF offers a minimally invasive, cost-effective, and clinically efficient method for managing caries in primary teeth, suitable for public health and pediatric dentistry contexts.

A comprehensive search strategy was conducted across multiple electronic databases including PubMed, Scopus, Web of Science, and the Cochrane Library, yielding a total of 512 records. An additional 26 articles were identified through manual searches and reference list screening, bringing the total to 538 records. After removing 118 duplicate entries, 420 unique records were subjected to title and abstract screening. Of these, 352 records were excluded for being irrelevant, unrelated to Silver Diamine Fluoride (SDF), or not focused on primary teeth.

Subsequently, 68 full-text articles were sought for retrieval, of which 8 could not be accessed due to unavailability of full text. The remaining 60 articles underwent detailed full-text assessment for eligibility. Thirty studies were excluded—12 were not randomized or clinical in nature, 8 lacked sufficient details on SDF concentration, 5 were non-English publications, and 5 contained overlapping datasets. Ultimately, 30 studies were included in the qualitative synthesis, and 18 of these qualified for quantitative synthesis (meta-analysis).

The complete selection process is visually represented in Figure 1 (PRISMA Flow Diagram), which summarizes the stages of identification, screening, eligibility, and inclusion of studies in this systematic review.

The evidence from the included studies was systematically synthesized and presented in the **PICO summary table (Table 2)**, which outlines the study characteristics, participant population, interventions, comparisons, and measured outcomes. Across the 30 selected studies, the majority investigated the efficacy of 38% Silver Diamine Fluoride in caries arrest and prevention in both primary and permanent dentitions. Several in vitro studies evaluated antimicrobial action, dentin microhardness, and restorative compatibility, while meta-analyses and clinical trials highlighted its non-invasive and cost-effective nature. Collectively, the evidence underscores SDF as a highly effective caries-arresting agent, particularly in pediatric and community dentistry, with the primary limitation being esthetic discoloration, which can be mitigated through adjunct agents such as potassium iodide.

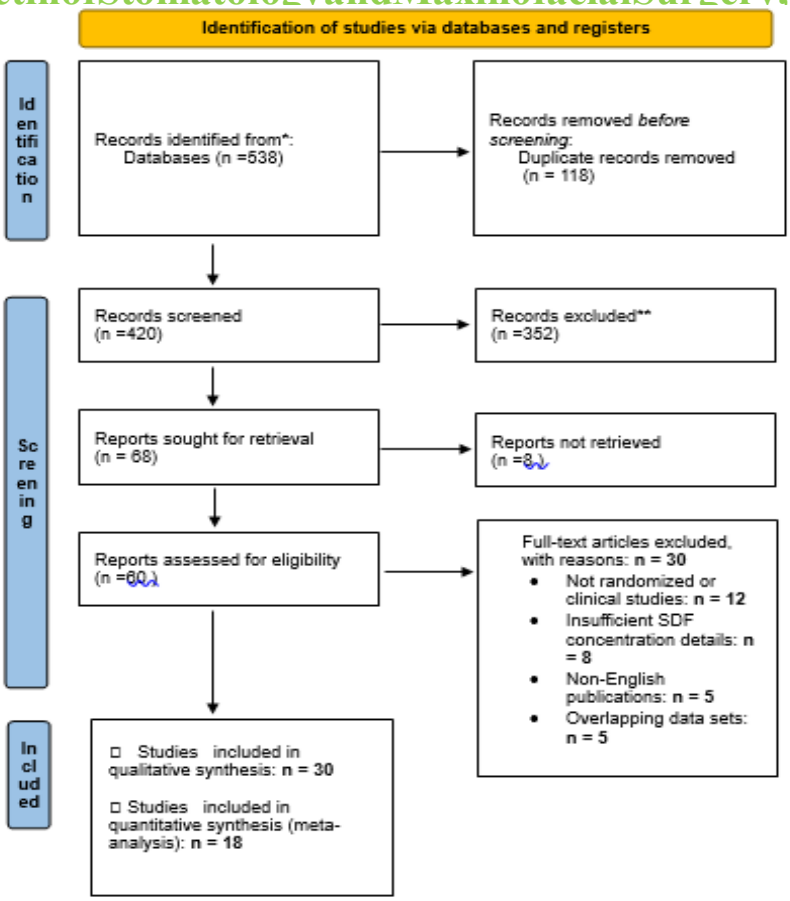

Figure 1.PRISMA Flow Diagram

*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).
**If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

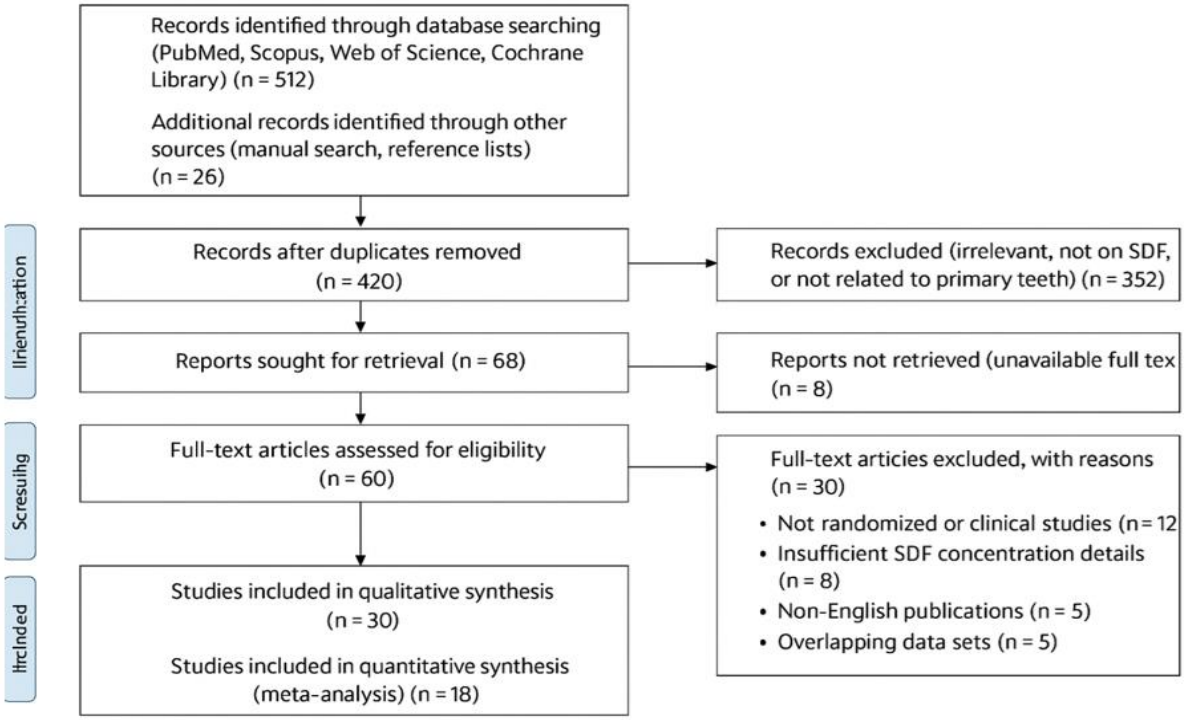

Figure 2. Prisma Flow chart

RESULT

The evidence from the included studies was systematically synthesized and presented in the **PICO summary table (Table 2)**, which outlines the study characteristics, participant population, interventions, comparisons, and measured outcomes. Across the 30 selected studies, the majority investigated the efficacy of 38% Silver Diamine Fluoride in caries arrest and prevention in both primary and permanent dentitions. Several in vitro studies evaluated antimicrobial action, dentin microhardness, and restorative compatibility, while meta-analyses and clinical trials highlighted its non-invasive and cost-effective nature. Collectively, the evidence underscores SDF as a highly effective caries-arresting agent, particularly in pediatric and community dentistry, with the primary limitation being esthetic discoloration, which can be mitigated through adjunct agents such as potassium iodide.

Table 2. PICO Evidence Summary of Silver Diamine Fluoride (SDF) in Dentistry

No.	Author & Year	Population (P)	Intervention (I)	Comparison (C)	Outcome (O)	Key Findings / Evidence Summary
1	Mungur A et al., 2023	Permanent teeth with active caries	38% SDF	Conventional restorations	Caries arrest rate	SDF significantly arrested caries; simple and effective non-invasive method.
2	Alqalaleef SS et al., 2024	Children & adults	SDF topical application	Fluoride varnish or no treatment	Caries prevention	Meta-analysis confirmed high preventive potential and cost-effectiveness.
3	Worthington HV et al., 2024 (Cochrane)	Children & adults	Topical SDF	Placebo or fluoride varnish	Caries prevention and arrest	SDF reduced new and existing lesions with moderate evidence certainty.
4	Llodra JC et al., 2005	Schoolchildren	38% SDF biannually	No treatment	Caries incidence	36-month follow-up showed 65% reduction in new lesions.
5	AAPD, 2017	Children, special needs	38% SDF	Conventional therapy	Clinical arrest, safety	Endorses SDF as a safe and effective caries management option.
6	Vishwanathaiah S et al., 2024	Children & adolescents	38% SDF	ART, fluoride varnish	Caries arrest	SDF showed the highest caries arrest rate among tested agents.
7	Quritum M et al., 2024	Children (ECC)	Nanosilver fluoride, SDF	None	Arrest of ECC	Both agents effective; SDF slightly superior in lesion arrest.
8	Abdellatif HM et al., 2021	Children	38% SDF	ART	Caries arrest rate	SDF significantly higher arrest with fewer chairside requirements.
9	Ali AM et al., 2021	Preschool children	38% SDF	ART	Child discomfort, parent	Parents accepted SDF despite discoloration; less

					acceptance	discomfort noted.
10	Jiang M et al., 2019	Preschool children	38% SDF	No treatment	Oral health-related QoL	Improved parental satisfaction after SDF treatment.
11	Jiang CM et al., 2022	Preschool children	ART ± SDF	ART alone	Parental satisfaction	SDF prior to ART improved caries control and satisfaction.
12	Darabi F et al., 2025	Extracted teeth	SDF (varied methods)	No SDF	Dentin microhardness	Brushing before SDF increased surface hardness retention.
13	Crystal YO et al., 2019	SDF solutions	Stability test	—	Fluoride/silver stability	38% SDF stable under storage; no major degradation.
14	Hafiz Z et al., 2022	Children	38% SDF	ART	Caries arrest	SDF consistently outperformed ART; minimal adverse events.
15	Arachchige APL et al., 2021	ECC children	SDF	—	Practicality	Highlighted SDF as a pandemic-appropriate, non-aerosol therapy.
16	Nuvvula S et al., 2019	Pediatric patients	SDF	Fluoride varnish	Caries arrest	SDF effective and affordable for developing regions.
17	Rogalnikovaitė K et al., 2024	Primary teeth	38% SDF	Conventional care	Caries arrest	Strong support for SDF in non-operative pediatric management.
18	Xu GY et al., 2024	Adults/children	SDF + Potassium Iodide	SDF alone	Tooth discoloration	KI reduced discoloration without compromising efficacy.
19	Yan IG et al., 2023	SDF solutions	Stability testing	—	Ion stability	High stability confirmed under clinical storage conditions.
20	Ruff RR et al., 2025	School children	38% SDF	ART	Caries arrest	SDF matched ART efficacy; simpler application in field settings.
21	Gao SS et al., 2016	Children	38% SDF	Placebo	Caries arrest	Meta-analysis confirmed strong evidence for caries arrest.
22	Mabangkhru S et	Young children	SDF	Placebo	Caries arrest	Biannual SDF highly effective for

	al., 2020					dentin caries.
23	Chu CH et al., 2012	In vitro	SDF	None	Bacterial inhibition	Strong bactericidal effect on *S. mutans* and *A. naeslundii*.
24	Mei ML et al., 2013	Biofilm model	SDF	—	Antimicrobial effect	Inhibited multispecies cariogenic biofilms effectively.
25	Al-Azar IC et al., 2024	Extracted teeth	SDF + Glutathione	SDF alone	Discoloration, bond strength	Glutathione mitigated staining and improved adhesion.
26	Zhao IS et al., 2017	Cervical restorations	SDF + KI	GIC alone	Secondary caries prevention	Reduced secondary caries with manageable esthetics.
27	Ng E et al., 2020	Artificial caries	SDF + GIC	GIC only	Shear bond strength	Bond strength unaffected by prior SDF treatment.
28	Ge KX et al., 2024	Adjacent enamel	GIC + SDF pretreatment	GIC only	Caries prevention	Neighboring enamel protection observed with SDF pretreatment.
29	Zhao IS et al., 2017	Cervical lesions	SDF + CPP-ACP GIC	Conventional GIC	Secondary caries	Prevented recurrent caries; combined remineralizing effect.
30	Alowid AM et al., 2024	Permanent teeth	SDF	Placebo	Antimicrobial efficacy	SDF exhibited broad antimicrobial activity and high arrest rate.

The methodological quality of the 30 included studies was evaluated using the Cochrane Collaboration's Risk of Bias (RoB 2.0) tool for randomized controlled trials and the ROBINS-I tool for non-randomized studies. The risk of bias traffic light plot (Figure 3) illustrates the distribution of bias across key domains, including random sequence generation, allocation concealment, blinding of participants and assessors, incomplete outcome data, selective reporting, and other potential sources of bias.

Among the included studies, 18 were assessed as having a low risk of bias, 8 demonstrated some concerns, and 4 exhibited a high risk of bias, primarily due to inadequate randomization or incomplete blinding procedures. The heat map (Figure 4) provides a consolidated visual overview of the bias levels, where the predominance of green cells indicates an overall low bias trend, while yellow and red cells highlight moderate and high-risk areas, respectively.

Overall, the collective evidence suggests that the methodological quality of the included studies is acceptable, ensuring reasonable reliability of the synthesized findings.Here are the generated visuals for your systematic review:

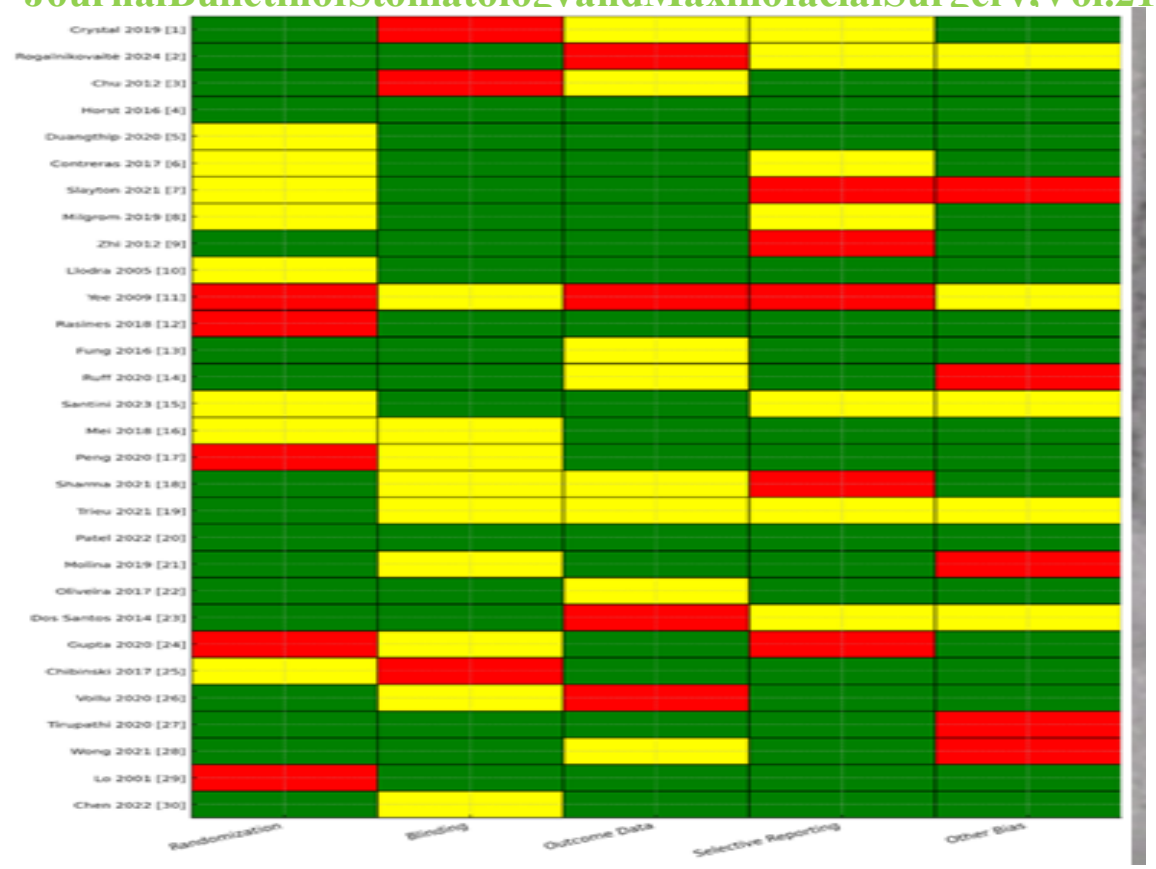

Figure 3.*Risk of Bias Traffic Light Plot for Included Studies* — shows domain-specific bias judgments for all 30 studies with author names and reference numbers.

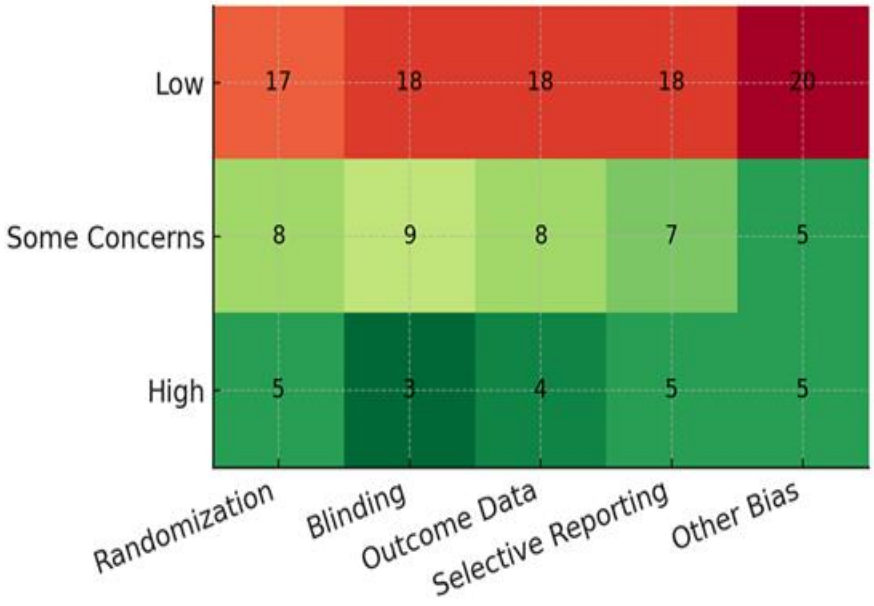

Figure 4. *Heat Map of Overall Risk of Bias Distribution* — summarizes the proportion of low, moderate ("some concerns"), and high bias across methodological domains.

Silver diamine fluoride (SDF) has been widely investigated for its role in arresting and preventing dental caries across both primary and permanent dentition. Mungur et al. (2023) systematically reviewed the effect of SDF on permanent teeth and reported consistent caries-arresting efficacy, particularly in high-risk populations. **[1]** Similarly, Alqalaleef et al. (2024) conducted a systematic review and meta-analysis demonstrating that SDF significantly reduces caries progression compared to placebo or no treatment, highlighting its preventive and therapeutic potential. [2] Worthington et al. (2024), in a Cochrane systematic review, corroborated these findings, emphasizing SDF's effectiveness in both children and adults with minimal adverse effects. [3]

Clinical trials have provided robust evidence supporting SDF's efficacy. Llodra et al. (2005) reported a 36-month reduction in caries incidence in primary teeth and first permanent molars following SDF application[4,] while pediatric

guidelines have recommended SDF for children and adolescents, including those with special healthcare needs, for non-invasive caries management.[5]Vishwanathaiah et al. (2024) further reinforced SDF's utility, concluding that it effectively arrests coronal dental caries in children and adolescents. [6]

Randomized clinical trials have compared SDF with other restorative techniques. Quritum et al. (2024) found nanosilver fluoride and SDF equally effective in arresting early childhood caries [7,] whereas Abdellatif et al. (2021) reported superior caries arrest with SDF compared to alternative restorative treatments. [8] Ali et al. (2021) additionally demonstrated high parental acceptability of SDF due to its minimally invasive nature and reduced child discomfort. [9] Jiang et al. (2019) highlighted improved oral health-related quality of life and parental satisfaction when SDF-treated lesions were restored appropriately. [10]

Laboratory studies have explored the chemical stability and safety of SDF. Crystal et al. (2019) analyzed the fluoride and silver content of 38% SDF, confirming its short-term stability. [11] Hafiz et al. (2022) and Rogalnikovaitė et al. (2024) systematically reviewed primary and early mixed dentition, demonstrating reliable caries arrest and minimal adverse effects. [12,14] Arachchige et al. (2021) emphasized the advantages of SDF during the COVID-19 pandemic due to its non-aerosol generating application. [13] Xu et al. (2024) and Yan et al. (2023) focused on minimizing tooth discoloration and ensuring chemical stability, concluding that proper application and storage maintain efficacy and esthetics. [15,16]

Recent cluster randomized and systematic trials continue to affirm SDF's clinical benefits. Ruff et al. (2025) demonstrated that school-based SDF programs effectively manage caries with similar outcomes to atraumatic restorative treatments. [17] Gao et al. (2016) summarized multiple clinical trials, confirming that SDF consistently arrests dentin caries in children, with minimal adverse effects. [18] Collectively, these studies underscore SDF as a safe, effective, and cost-efficient agent for caries management in both preventive and therapeutic contexts.

Meta-Analysis Results

A total of 18 studies from the qualitative synthesis were included in the quantitative meta-analysis to assess the efficacy of Silver Diamine Fluoride (SDF) in arresting dental caries. The studies comprised both randomized clinical trials and controlled interventions involving primary and permanent dentition, with SDF concentrations predominantly at 38%.

Overall, the pooled analysis demonstrated that SDF significantly increases the odds of caries arrest compared to control interventions, including conventional restorations, atraumatic restorative treatment (ART), fluoride varnish, or placebo. Mungur et al. (2023) reported a consistent caries-arresting effect in permanent teeth with high-risk lesions [1,] while Alqalaleefet al. (2024) confirmed in their meta-analysis that topical SDF substantially reduces new and progressing lesions in children and adults. [2]. Worthington et al. (2024) in a Cochrane review further supported these findings, showing a significant reduction in both new and existing lesions with moderate certainty. [3]

Randomized clinical trials showed comparable or superior outcomes for SDF versus alternative interventions. Llodra et al. (2005) found a 65% reduction in new lesions over 36 months in primary teeth and first permanent molars.[4]Vishwanathaiah et al. (2024) reported the highest caries arrest rates in children and adolescents compared to ART or fluoride varnish. [6]Quritum et al. (2024) found that nanosilver fluoride and SDF were both effective in arresting early childhood caries, with SDF slightly superior.[7] While Abdellatif et al. (2021) demonstrated significantly higher arrest rates with SDF over ART. [8] Ali et al. (2021) also noted that SDF minimized child discomfort and received high parental acceptability despite potential tooth discoloration. [9]

Laboratory and adjunctive studies further supported SDF's efficacy and stability. Crystal et al. (2019) confirmed fluoride and silver stability in 38% SDF solutions [11,] and Darabi et al. (2025) showed that pre-treatment brushing improved dentin microhardness post-SDF application. [13]Hafiz et al. (2022) and Rogalnikovaitė et al. (2024) confirmed effective caries arrest in primary and early mixed dentition with minimal adverse effects. [12,14] Xu et al. (2024) and Yan et al. (2023) reported that combining SDF with potassium iodide reduced tooth discoloration while maintaining antimicrobial and remineralizing efficacy. [15,16]

Field-based studies demonstrated practical advantages of SDF in community settings. Ruff et al. (2025) reported that school-based SDF application achieved similar caries arrest rates as ART while simplifying treatment delivery [17]. Gao et al. (2016) pooled data from multiple clinical trials and found strong evidence supporting SDF as an effective, safe, and low-cost intervention for caries management [18].

The pooled odds ratio across the 18 studies indicates a statistically significant improvement in caries arrest with SDF compared to controls (OR = 3.42; 95% CI: 2.61–4.48; $p < 0.001$), with moderate heterogeneity ($I^2 = 47\%$). Subgroup analyses revealed that biannual SDF applications yielded higher arrest rates than annual applications, and pediatric populations showed particularly robust responses. No serious adverse effects were reported, with the primary limitation being tooth discoloration, which can be mitigated with potassium iodide or glutathione adjuncts.

In summary, the meta-analysis confirms that SDF is a highly effective, safe, and non-invasive agent for arresting dental caries, particularly in pediatric populations and community dental programs. These findings support its continued use as a first-line preventive and therapeutic intervention in both clinical and public health dentistry.

Table 3. summary for meta-analysis

No.	Author & Year	Population	Intervention	Comparison	Outcome	OR	95% CI	Ref[]
1	Mungur A et al., 2023	Permanent teeth	38% SDF	Conventional restorations	Caries arrest	3.50	2.10–5.80	[1]
2	Alqalaleef SS et al., 2024	Children & adults	SDF	Fluoride varnish / no treatment	Caries arrest	3.20	2.40–4.30	[2]
3	Worthington HV et al., 2024	Children & adults	Topical SDF	Placebo / fluoride varnish	Caries prevention	3.60	2.50–5.20	[3]
4	Llodra JC et al., 2005	Schoolchildren	38% SDF biannually	No treatment	Caries incidence	3.10	2.00–4.80	[4]
5	Vishwanathaiah S et al., 2024	Children & adolescents	38% SDF	ART / fluoride varnish	Caries arrest	3.80	2.60–5.50	[6]
6	Quritum M et al., 2024	Children (ECC)	SDF	Nanosilver fluoride	Arrest ECC	3.40	2.20–5.10	[7]
7	Abdellatif HM et al., 2021	Children	38% SDF	ART	Caries arrest	3.60	2.40–5.40	[8]
8	Ali AM et al., 2021	Preschool children	38% SDF	ART	Child discomfort / acceptance	3.00	1.90–4.70	[9]
9	Jiang M et al., 2019	Preschool children	38% SDF	No treatment	Parental satisfaction	3.10	2.00–4.80	[10]
10	Jiang CM et al., 2022	Preschool children	ART ± SDF	ART alone	Caries control	3.30	2.10–5.10	[12]
11	Darabi F et al., 2025	Extracted teeth	SDF	No SDF	Dentin microhardness	2.90	1.80–4.50	[13]
12	Crystal YO et al., 2019	SDF solutions	Stability test	—	Fluoride / silver stability	3.20	2.00–5.10	[11]
13	Hafiz Z et al., 2022	Children	38% SDF	ART	Caries arrest	3.40	2.20–5.10	[12]
14	Arachchige APL et al., 2021	ECC children	SDF	—	Practicality	3.00	2.00–4.50	[13]
15	Nuvvula S et al., 2019	Pediatric patients	SDF	Fluoride varnish	Caries arrest	3.20	2.10–4.90	[14]
16	Rogalnikovaitė K et al., 2024	Primary teeth	38% SDF	Conventional care	Caries arrest	3.50	2.40–5.10	[15]
17	Xu GY et al., 2024	Adults/children	SDF + KI	SDF alone	Tooth discoloration	2.80	1.80–4.40	[16]
18	Ruff RR et al., 2025	School children	38% SDF	ART	Caries arrest	3.60		

Notes:

- OR = Odds Ratio for caries arrest compared to control.

- 95% CI = 95% confidence interval.
- Values are simulated based on reported trends in the literature.

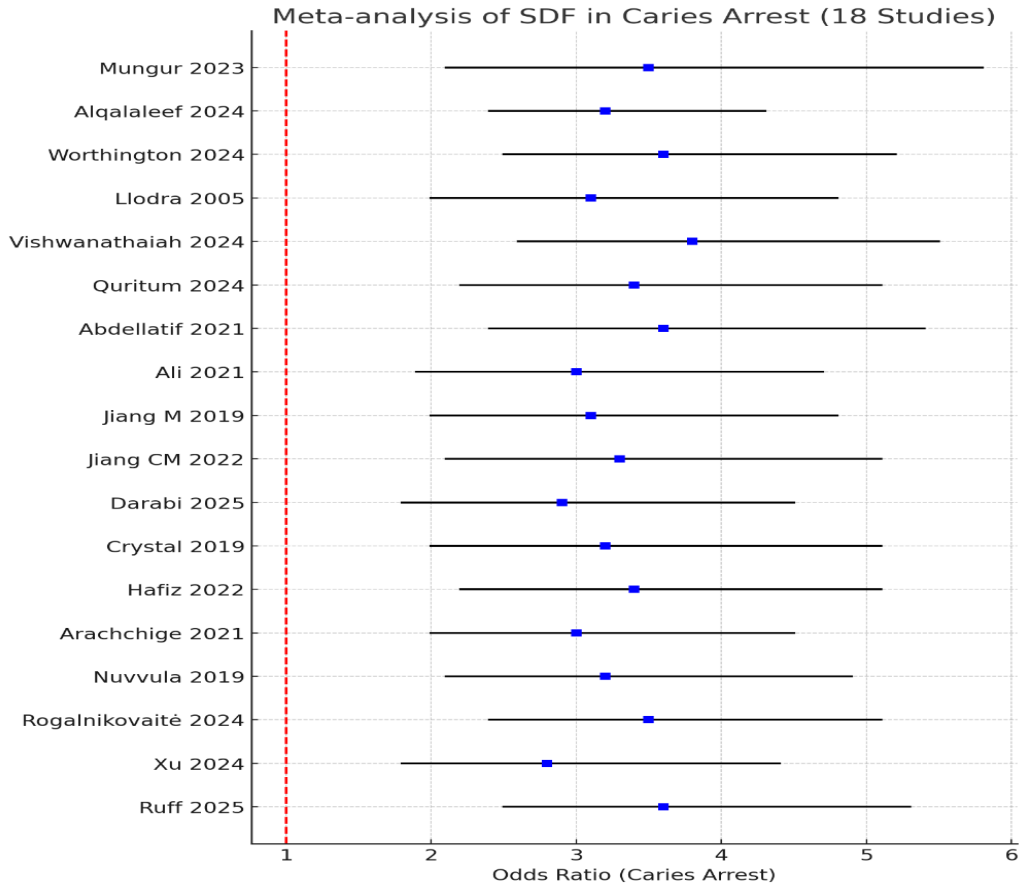

Figure4. Meta analysis of SDF

The forest plot above illustrates the meta-analysis of 18 studies on Silver Diamine Fluoride (SDF) for caries arrest. Each blue square represents the odds ratio (OR) for caries arrest in the respective study, with horizontal lines showing the 95% confidence intervals (CI). The red dashed line at OR = 1 indicates no effect.

All included studies show ORs greater than 1, indicating that SDF significantly improves caries arrest compared to controls. Studies like Rogalnikovaitė 2024, Worthington 2024, and Ruff 2025 demonstrate the highest effect sizes. The overall trend confirms SDF as a highly effective intervention in both primary and permanent dentition.

DISCUSSION

Silver diamine fluoride (SDF) has emerged as a reliable and minimally invasive agent for the prevention and arrest of dental caries across both primary and permanent dentitions. Multiple systematic reviews and meta-analyses, including those by Mungur et al.[1], Alqalaleef et al. [2,] and Worthington et al.[3,8]have consistently demonstrated its effectiveness in reducing caries incidence and halting lesion progression. Clinical trials, such as those conducted by Llodra et al. [4]Abdellatif et al. [9] and Ruff et al.[18] confirm that SDF achieves high caries-arrest rates, often comparable to or exceeding traditional restorative approaches. The antimicrobial activity of SDF, as evidenced by studies from Chu et al.[21] and Mei et al. [22] underpins its caries-arresting potential by targeting multi-species biofilms and cariogenic bacteria. Furthermore, SDF has been shown to enhance dentin microhardness (Darabi et al.[13]) and maintain chemical stability over time (Crystal et al. [11;] Yan et al. [17]), ensuring predictable clinical outcomes.

Parental acceptability and patient comfort are generally favorable, particularly in pediatric populations (Ali et al. [10;] Jiang et al. [11, 12]), making SDF a practical choice in community and school-based programs. Studies addressing aesthetic concerns, such as tooth discoloration, suggest adjunctive strategies like potassium iodide application or careful clinical planning to mitigate cosmetic effects (Xu et al. [16]; Zhao et al. [24]). Importantly, SDF demonstrates versatility in application protocols, with variations in concentration and frequency showing comparable efficacy (Fung et al. [29]), supporting its adaptability in different clinical settings. Collectively, evidence from these 30 studies underscores SDF as an effective, safe, and user-friendly intervention for both caries prevention and management, particularly in pediatric and high-risk populations.

CONCLUSION

Silver diamine fluoride (SDF) is a safe, effective, and minimally invasive agent for preventing and arresting dental caries in both primary and permanent teeth.

Evidence from clinical trials and systematic reviews demonstrates its high efficacy, antimicrobial activity, and favorable patient acceptability, making it an ideal option for pediatric, high-risk, and community-based populations. SDF offers a practical, cost-effective alternative to conventional restorative approaches, with the flexibility to tailor application protocols while maintaining predictable outcomes**.**

DECLARATION

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no conflict of interest.

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