



Impact of Silver Diamine Fluoride on Oral Health Related Quality of Life (Ohrqol)-A Literature Review

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Silver diamine fluoride (SDF) has emerged as an effective agent for arresting and preventing caries. It offers an immediate inhibition of caries process thereby reducing pain and suffering in those who lack access to quick restorative /prosthetic rehabilitation. It may impact oral health related quality of life (OHRQoL).

Aim: This literature review is aimed at reviewing the SDF versus other standard care therapies and exploring their impact on OHRQoL.

Methodology: Literature was searched by two independent reviewers to recognise the English language papers in the four most commonly used databases: Medline, PubMed, Embase, and Scopus. Search included 11 randomised controlled trials that used SDF as an intervention either alone or with comparative agent/treatment for caries arrest and studies that considered oral health-related quality of life as an associating factor.

Results: Two studies used application of SDF solution or placebo as intervention, few adopted use of comparator agent or/and alternative treatment and some adopted single sample pre-post

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designs with isolated SDF use. Different versions of Early Childhood Oral Health Impact Scale (ECOHIS) was used by most studies for assessment of oral health-related quality of life. While two studies (Ruff et al, Hiremath et al) used the Child Oral Health Impact Profile (COHIP).

Conclusion: SDF application may increase the quality of life of children as perceived by their parents and SDF staining is not a concern for both of them.

Keywords: Silver diamine fluoride; oral health related quality of life; dental caries.

1. INTRODUCTION

Dental caries not only affects oral health but also has profound effects on general health. Untreated dental caries may progress to severe dental infection and orofacial pain compromising the ability to chew and eat. This may lead to functional impairment by affecting individual's growth and development. The pain and suffering might impact psychosocial well being also [1,2]. Early childhood caries (ECC) is a detrimental disease involving young children which burdens societies worldwide. Its prevalence has recently shown a widespread increase in children aged 2–5 years, making them a target group for the Federation Dentaire Internationale.

Silver diamine fluoride has emerged as a noninvasive effective therapy for arresting active carious lesions and preventing occurrence of new caries by exerting its remineralising effects. Its non surgical approach along with ease of use, makes it desirable, specially for developing low income countries where population encounter low accessibility and utilisation of basic dental procedures and struggle to combat the economic burden placed on them due to high costs of caries treatment. Its cost-effectiveness, and simple application procedure also advocates its use as an appropriate intervention for community settings [3,4].

Over the past decade, silver diamine fluoride (SDF) has been frequently discussed in the literature due to its simple application protocol with a minimum number of visits and potential anti-cariogenic properties in primary dentition. In addition to the cariostatic activity, the distinguishing feature of SDF is that it also simultaneously prevents the formation of new caries when compared with other materials. SDF is used commonly at a concentration of 38% (24-27% silver, and 5-6% fluoride, 7, 5-11% ammonia). Recent research on SDF evidenced its high efficacy in caries arrest owing to its immediate antibacterial action. SDF is bactericidal to cariogenic bacteria and inhibits the

growth of bacterial biofilms. It also inhibits degradation of the organic collagen matrix. It hampers demineralisation and promotes the remineralisation of demineralised tissues of teeth [5-10].

Its potential drawback is immediate blackening of teeth post its application resulting from oxidizing effects of SDF, observed by many researchers.[11] This causes aesthetic concerns and discontent of parents, restricted socialising by children which negatively impacts their oral health-related quality of life.[12] Although few researchers used agents like potassium iodide and tannic acid to minimise the staining but results were not very satisfactory. Negligence of caries treatment is often correlated with poor oral health-related quality of life (OHRQoL). Oral health-related quality of life (OHRQoL) is defined as a "multidimensional construct involving diverse subjective evaluations, it is composed of six primary elements namely oral health, biological disease, emotional well being, functional Status, health Perceptions, sense of self and general quality of life [13].

Numerous researchers explored the effects of dental caries on oral health-related quality of life. Few of them observed improvement in OHRQoL by Sdf use but some found no apparent effect of its use on OHRQoL in children.[14,15] These These variable views makes it imperative to conduct an in-depth search of the available literature. Therefore, the purpose of this review was to assess literature to know the impact of SDF treatment on OHRQoL of children.

2. MATERIALS AND METHODS

2.1 Search and Extraction

The present review used a combination of controlled vocabulary and free text terms as the search strategy. Literature was searched by two independent reviewers to recognise the English language papers. PubMed, Medline, Scopus and Embase were the main electronic databases

used to access the studies. In order to obtain additional relevant publications a search was performed manually from the list of references of all primary studies. The sorting of papers from databases was done by adopting a planned strategy.

Search terms used were 'silver fluoride' OR 'silver diamine fluoride' OR 'silver diammine fluoride' OR 'diamine silver fluoride' OR 'diammine silver fluoride' OR silver ammonia fluoride AND 'dental caries' OR 'Early childhood caries' OR 'dentinal caries' OR 'cariou lesion' AND 'quality of life' OR 'qol' OR 'oral health related quality of life' OR 'ohrqol'. Relevant studies were identified from the reference list of possible eligible papers and were searched manually. The papers which have taken silver diamine fluoride as an intervention for arresting caries and have used a validated quantitative instrument for evaluating oral health-related quality of life were included in the review. The studies with no information concerning OHRQoL as well as narrative reviews, case reports, and conference papers were excluded. Randomised controlled trials that used SDF as an intervention either alone or with comparative agent/treatment for caries arrest like with fluoride varnish, GIC based sealants, atraumatic restorations (ART), or combinations of therapies (ART/ fluoride varnish) and studies that considered oral health-related quality of life as an associating factor were included in the review.

The ECOHIS is basically a validated questionnaire and a standardised assessment

tool for OHRQoL which records parents/caregiver responses of preschool children. ECOHIS consists of 13 questions divided into 2 sections: the child impact section (CIS) which has 4 domains (symptoms, function, psychological, self-image/social interaction) and the family impact section (FIS) which has 2 domains (parent distress, family function). Responses were coded according to ECOHIS protocol: 0 = never, 1 = hardly ever, 2 = occasion- ally, 3 = often, 4 = very often, 5 = don't know.

2.2 Study Selection

30 papers were identified after the comprehensive search of databases (Fig- 1). The two reviewers independently screened the papers and removal of duplicates was done by using End-Note X7. After eliminating the duplicate publications, reviewers extracted the relevant studies in accordance with pre-decided inclusion and exclusion criteria. Screening of titles and abstracts was done, during which publications in which the SDF was not used for caries arrest were excluded. After a detailed discussion and thorough examination of the titles and abstracts reviewers yielded 15 studies. Full texts of selected articles were obtained and were screened independently by reviewers for their quality assessment and those found irrelevant were excluded. Finally 11 studies were selected which were adhering to pre-decided inclusion/exclusion criteria and considered to be included in the review.

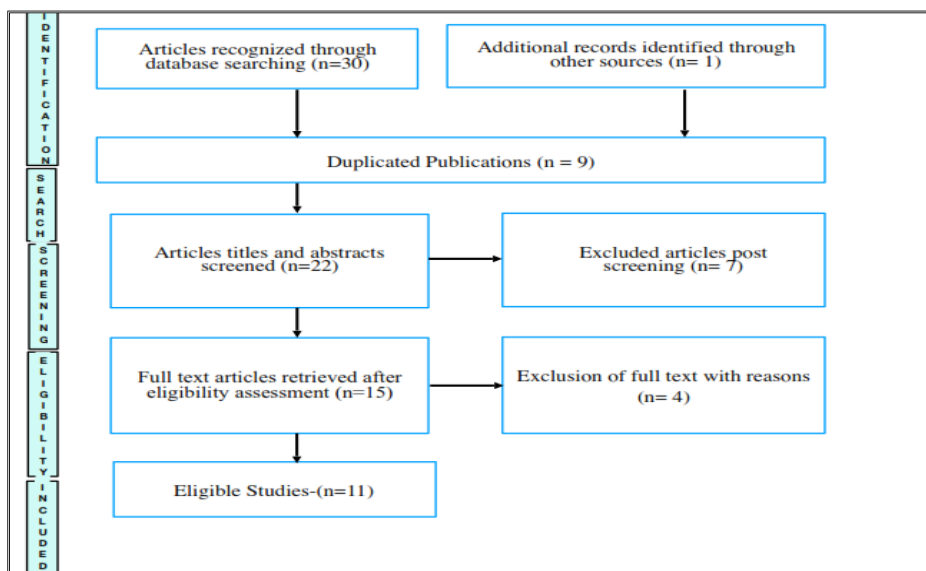


Fig. 1. Flow chart describing Study protocol

3. RESULTS

The present review paper had an input towards randomised controlled trials with slight variability in study designs. Tables were formulated with the following extracted information: author/year, title, country, study setting, sample size, intervention, comparator, OHRQoL assessor and its outcomes. Interventions with comparator group as well as self intervention groups were included for analysis.

A total of 5 studies selected for review are summarized in Table 1. Two studies (Jiang et al, 2019)(Jiang et al, 2020) used application of SDF solution or placebo as intervention and the rest of them adopted use of comparator agent

or/and alternative treatment(Ruff et al 2021), (Rodrigues et al, 2020), (Vollu et al, 2019). All included trials described sample size estimation. Jiang et al 2019 selected 187 children at kindergartens in Hong Kong, Jiang et al 2020 studied a sample of 253 kindergartens children from Hong Kong, Ruff et al 2021 had taken 246 New York city school children as their study subjects, Rodrigues et al 2020 studied around 108 children visiting private dental clinics of Brazil and 26 children from Paediatric Dental Clinic of Rio de Janeiro were recruited by Vollu et al 2019. Ruff et al assessed the oral health related quality of life of children using Child Oral Health Impact Profile (COHIP) while other studies included used ECOHIS questionnaire tool for evaluation (Table 1).

Table 1. Summary of articles using SDF solution or placebo as intervention as well as comparator agent or/and alternative treatment

S. No	Author / Year / Country	Study detting / design / follow-up duration	Sample size initially - at follow up/ ages	Intervention	Comparator	OHRQoL / assessor	Outcomes
1	Jiang et al 2019 China	KG / RCT / 6 months	194 (187) / 3-4 years	SDF application	Placebo	C-ECOHIS / parent	ART placement method
2	Jiang et al 2020 China	KG / RCT / 10 months	260 (253) / 3-4 years	SDF application	Placebo	C-ECOHIS / parent	Non significant parental satisfaction with SDF application
3	Vollu et al 2019 Brazil	Paediatric dental clinics / RCT / 3,6,12 mo	N-68 (33, 29, 26) / 2-5 years	ART / SDF	ART	B-ECOHIS / parent	SDF have similar effects as ART on caries arrest and OHRQoL
4	Rodrigues et al 2020 Brazil	Paediatric dental clinics / RCT / 15 days - 3 more days	N-118 (108) / 2-5 years	ART / SDF	ART	B-ECOHIS / parent	Both treatments have positive impact in OHRQoL
5	Ruff et al 2021 USA	School children RCT / 6 mo	N-1323 (160) / 5-13 years	SDF+ FV	ART+ FV	COHIP-SF / Child	OHRQoL in children receiving SDF showed no appreciable change relative to other therapies

Table 2. Summary of articles that adopted single sample pre-post designs with isolated SDF use

S. No	Author / Year / Country	Study setting / design / follow-up duration	Sample size initially - at follow up/ ages	Intervention	OHRQoL / assessor	Outcomes
1	Caroline et al 2018 Indonesia	Kindergartens experimental study with parallel control / 3 mo	59 / 3-5 years	SDF	ECOHIS / parent	Increased OHRQoL
2	Duangthip et al 2019 China	Kindergartens school setting / 6 mo / RCT	117 (113) / 4-5 years	SDF	C-EOHIS	SDF treatment didn't affect OHRQoL
3	Cernigliaro et al 2019 USA	Community health centers cross sectional, interim treatment	8 / 0-14 years	SDF	ECOHIS / parent	Caregiver perception of children OHRQoL was high
4	Hiremath et al 2020 India	HIV care home cross sectional study / 4 mo	42 / 12-16 years	SDF	COHIP-SF/ Child	Emotional well being was significantly impacted negatively following SDF application
5	Sihra et al 2020 Canada	Community clinics Winnipeg cohort / 4 mo 8 mo	40 / 0-6 years	SDF+ FV	A-ECOHIS / parent	OHRQoL was not affected by success of SDF treatment
6	Renuga Lakshmi et al 2020 Saudi Arabia	Dentistry college Jazan cohort study / 4 weeks	51 / 2-6 years	SDF	ECOHIS / parent	SDF significantly improved the OHRQoL of uncooperative preschool children

Table 2 depicted a summary of few articles that adopted single sample pre-post designs with isolated SDF use. (Duangthip et al, 2018), (Caroline, 2018), (Cernigliaro et al, 2019), (Hiremath et al, 2020), (Shira et al, 2020), (Renugalakshmi et al, 2021). Study subjects in most studies were preschool age children except for one study (Hiremath et al) where 12-16 yr old HIV patients comprised the study population. Duangthip et al 2018 studied a sample of 226 children in six kindergartens in Hong Kong, Cernigliaro et al 2019 studied 48 children from community health care centres USA, 84 children were taken as sample by Hiremath et al 2020 from care home designated for HIV children, 40 Canadian children from 3 community clinics in Winnipeg were involved by Shira et al 2020,

Renugalakshmi et al 2021 assessed 51 children at dental clinic of the College of Dentistry (Jazan University) and Caroline et al 2018 studied 59 children recruited from kindergarten in Indonesia. Different versions of Early Childhood Oral Health Impact Scale (ECOHIS) was used by most studies for assessment of oral health-related quality of life. While a study by Hiremath et al used the Child Oral Health Impact Profile (COHIP). Assessment was done on the basis of 5 point likert scale (5 = very satisfied, 1 = very dissatisfied) (Table 2).

4. DISCUSSION

This review is based on evidence from papers that assessed the impact of SDF treatment on

OHRQoL. AAPD has recently released clinical practice guidelines for SDF and also advocated its use for caries management. SDF application for caries arrest demonstrated high effectiveness ranging from 35-95% which makes it a desirable caries inhibiting agent. The noninvasive approach and its ease of application makes it a material of choice for use in community settings. The amount of fluoride present in 38% SDF is 44,800 ppm due to which it is an effective measure for use in high risk patients. Fluoride advances the remineralisation of hydroxyapatite in enamel and dentine and aids in caries prevention. SDF caries arresting potential offers its use as an interim alternative treatment for paediatric patients in whom attempting complex procedures is challenging. Although researchers have proved SDF to be effective in caries arrest but observed that its potential adverse effects and tooth staining restricts its use. It is hypothesised that these factors may affect the OHRQoL of life of patients receiving SDF treatment [16].

Carnigliaro et al assessed the caregivers' satisfaction towards SDF as interim measure prior to treatment under sedation and found that parents satisfaction post SDF application was high and tooth blackening was not a concern for them.[17] Another study, Hiremath et al evaluated the impact of Sdf treatment on the OHRQoL among HIV children by using it as an interim step before definitive treatment. They evaluated OHRQoL from child's perception and recorded children responses using for C-ECOHIS unlike other studies that recorded parents perception. However, they selected HIV adolescents study subjects who were aged between 12-16yrs and this eventually made it possible to record their responses but this is not possible in case of small age group children. It was observed that tooth staining and taste alterations affected the emotional dimension of child's OHRQoL.[18] On the contrary, two studies (Duangthip et al., Jiang et al.) stated that SDF treatment did not affect the overall OHRQoL of preschool children and their families [19,20].

Ruff et al considered baseline decay status as an important determinant and observed that OHRQoL was already compromised in such children. Thus they scored significantly worse, irrespective of caries arrest intervention. However children were seen in OHRQoL post both interventions namely silver diamine fluoride or sealants/ART.[21] Four more studies (Duangthip et al., 2019; Jiang et al., 2020, 2019;

Sihra et al., 2020; Vollu et al., 2019) included in the present review showed similar/consistent results and reported no difference in impact on OHRQoL with alternative treatments, such as ART, fluoride varnish, or placebo [19,20,22, 23,24].

The studies included in this review predominantly did the assessment at baseline and at the end of follow up period but another study by Rodrigues et al adopted a mid 15 day evaluation to observe whether the positive impact on the treatments had dissipated over time.[25] They observed a positive impact on OHRQoL at 15 days and reported no change, even after a three-month follow-up period. Moreover, authors found a reduced prevalence parameters like guilty/upset parents and tooth/mouth/jaw pain both 15 days and three months after treatment compared to the baseline on evaluating B-ECOHIS questions unlike Duangthip et al who rated these as the most frequent impacts and observed an increase in "feeling guilty" six months after treatment with SDF. This parameter "felt guilty" showed an increased values, which may be due to increase in parents distress since black staining kept reminding the parents of their child's past caries experience daily.

Renugalakshmi et al appreciated the magnitude of SDF impact on the OHRQoL of uncooperative children and selected children with a Frankl rating 2 specifically. Certain measures were taken to deal with the uncooperative behaviour like 'no caries removal' approach was followed in order to reduce the chair side time. An improvement to frankl rating 3 was observed in 90% children. The strength of the present study was the participation of 100% of the patients (no dropouts) that might be because of short-term follow-up of patients for four weeks [26].

Sihra et al emphasised the role of oral hygiene practices along with SDF use for caries arrest and stated that brushing twice a day would enhance its efficacy. In the study children requiring emergency dental treatment were excluded, thus selected children had higher OHRQoL initially with less extensive dental needs which made treatment benefits less pronounced in these children. Also this study did not record ECOHIS responses at baseline so comparison regarding potential change in OHRQoL between the baseline and second visit would not be identified. [23]

By focusing on the ECOHIS sub-scale component FIS, Vollu et al observed that parents of ART group children were less anxious at their second follow up visit. Although, they justified that the parents in SDF group were not worried about the appearance, but were concerned about non restoration of tooth anatomy which would compromise masticatory ability and felt guilty and distressed about it.[24] Caroline et al observed significant increase in M-ECOHID score at 3 months follow up and suggested that SDF application in toddlers with primary teeth caries increases their quality of life when coupled with dental health education [27].

5. CONCLUSION

Based on this literature review, we can conclude by stating that sdf has promising effects on the inhibition of active caries. It can be used as an interim agent and offers an intermediate care path for pediatric population who doesn't have an immediate access to absolute treatment. Moreover sdf application may increase the quality of life of these children as perceived by parents and sdf staining is not a concern for the parents and children. Thus this review suggested that there should be more studies that could address the frequency and intensity of sdf when used in conjunction with adjunctive preventive agents (eg, sdf with/ without fv), time of application and follow on restorative care of patients.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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