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Knowledge, awareness and attitude among dentists regarding use of Silver Diamine Fluoride (SDF) in preventing dental caries

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Abstract :

Background:

Dental caries remains one of the most prevalent oral health problems worldwide, particularly among children and socioeconomically disadvantaged populations. Silver Diamine Fluoride (SDF) has emerged as a simple, affordable, and minimally invasive therapeutic option for arresting and preventing dental caries. However, the successful implementation of SDF in clinical practice depends largely on dentists' knowledge, awareness, and attitude toward its use.

Aim:

This study aimed to evaluate the knowledge, awareness, and attitude of dentists in Iraq toward the use of Silver Diamine Fluoride in the prevention and management of dental caries.

Materials and Methods:

A cross-sectional online survey was conducted among dentists in Iraq using a structured questionnaire. The questionnaire assessed dentists' knowledge, awareness, clinical experience, and attitude regarding the use of SDF in dental practice. A total of 150 dentists participated in the study. The collected data were analyzed statistically using appropriate descriptive statistical methods.

Results:

The findings showed that the majority of participants had a moderate level of knowledge regarding SDF use, representing 57.0% of the respondents. Regarding attitude, nearly half

of the participants demonstrated a moderate attitude toward SDF, accounting for 49.0%, while 29.8% showed a positive attitude toward its clinical application.

Conclusion:
The study revealed that most dentists in Iraq had a moderate level of knowledge and attitude toward Silver Diamine Fluoride. Although SDF is considered an effective, affordable, and minimally invasive option for caries prevention and management, its wider clinical use may depend on improving dentists' awareness, practical training, and confidence in its application. Therefore, continuing dental education programs are recommended to enhance the implementation of SDF in routine dental practice.

Keywords: Silver Diamine Fluoride, dental caries, dentists, knowledge, awareness, attitude, Iraq.

Introduction

Dental caries is one of the most prevalent oral diseases worldwide and continues to represent a major public health problem, particularly among children. It is a multifactorial, biofilm-mediated disease influenced by dietary habits, oral hygiene practices, fluoride exposure, socioeconomic status, and access to dental care. If left untreated, dental caries may lead to pain, infection, difficulty in eating, drinking, and sleeping, and may negatively affect a child's general health, growth, school performance, and overall quality of life [1].In Iraq, dental caries remains a significant oral health concern among children and adolescents. According to the National Oral Health Survey in Iraq, the prevalence of dental caries among the Iraqi population aged 3–18 years was approximately 52%. Furthermore, a systematic review published in 2018 reported that the prevalence of untreated dental caries among children below six years of age in Iraq was 49.6%.[2,3]. These findings highlight the need for effective preventive and minimally invasive strategies to control dental caries, especially among young children.The burden of dental caries is often higher among socioeconomically underprivileged communities [4]. This may be related to limited awareness of preventive oral health measures, poor dietary practices, reduced access to professional dental services, and financial barriers to receiving conventional restorative treatment. In such communities, untreated caries may progress rapidly and lead to complications that require more complex and costly dental interventions. Therefore, simple, affordable, effective, and non-invasive approaches are essential for improving oral health outcomes, particularly among children and underserved populations.Silver Diamine Fluoride (SDF) has recently gained increasing attention as a minimally invasive agent for arresting dental caries. SDF is a topical liquid material that can be applied directly to cavitated carious lesions without the need for local anesthesia, drilling, or removal of infected soft dentin[5,6]. It has been used for arresting

active carious lesions and for the management of dentin hypersensitivity. The clinical effectiveness of SDF is mainly attributed to the combined action of silver and fluoride ions. Silver has antimicrobial properties that help reduce cariogenic bacteria, while fluoride promotes remineralization and increases the resistance of tooth structure to acid dissolution.SDF was approved by the Food and Drug Administration (FDA) as a desensitizing agent in August 2014, and it became available in the United States in April 2015 [7]. Previous studies have reported that 38% SDF is effective in arresting and preventing carious lesions [4]. In addition to its clinical effectiveness, SDF is inexpensive, easy to apply, requires minimal equipment, and can be used in community-based oral health programs. These advantages make SDF particularly useful for young children, patients with special health care needs, and individuals who are unable to tolerate conventional dental treatment.Despite these advantages, the use of SDF may still be limited by several factors, including lack of knowledge among dental practitioners, limited clinical training, concerns regarding black staining of arrested carious lesions, and uncertainty about patient or parent acceptance. Therefore, dentists' knowledge, awareness, and attitude toward SDF play an important role in its successful implementation in routine dental practice and public health programs.From a public health perspective, SDF represents a valuable tool for managing dental caries in young and uncooperative patients because it reduces discomfort, pain, treatment time, and the need for invasive dental procedures[4]. However, its successful adoption depends largely on the awareness and acceptance of dental professionals. Therefore, this study aims to evaluate the knowledge, awareness, and attitude of dentists in Northern Iraq regarding the use of Silver Diamine Fluoride in the prevention and management of dental caries.

MATERIALS AND METHODS

Study Design and Sample

An online cross-sectional study was conducted among general dentists, pediatric dentists, and postgraduate dental students in Iraq between October 2025 and March 2026. A total of 150 participants were included in the study using a convenience sampling technique. Participants who were willing to take part in the survey and completed the online questionnaire were included in the final analysis.

Survey Instrument and Data Collection

A prevalidated, self-administered questionnaire was used to evaluate the knowledge, awareness, and attitude of dentists in Iraq toward the use of Silver Diamine Fluoride (SDF). The questionnaire was prepared based on previously published studies.^4,5,6

The survey was designed using Google Forms and distributed electronically to the target participants. The questionnaire included multiple-choice and fill-in response items. It consisted of 12 questions designed to assess dentists' knowledge, awareness, clinical experience, and attitude regarding the use of SDF in the prevention and management of dental caries.

Before participation, the aim of the study was explained to the respondents, and participation was voluntary. The collected responses were checked for completeness and then statistically analyzed using appropriate descriptive statistical methods

Statistical Analysis

The collected data were entered into a database and analyzed using appropriate statistical software. Descriptive statistics, including frequencies and percentages, were used to summarize participants' responses regarding knowledge, awareness, and attitude toward SDF. The results were presented in tables and figures where appropriate.

RESULTS

This chapter presents the findings of the study according to the predefined objectives. The results are organized and summarized using descriptive statistical methods and are presented in tables for clarity. The first section focuses on dentists' knowledge regarding Silver Diamine Fluoride (SDF), including their awareness of the material and and the primary sources from which they obtained information about it.

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Part I: Knowledge of Dentist regarding Silver Diamine Fluoride

Table 1. General Knowledge and Source of Information about Silver Diamine Fluoride

Item	Response	Frequency (n)	Percentage (%)
Knowledge about SDF	Yes	129	85.4
	No	22	14.6
	Total	151	100.0
Source of education about SDF	Self-reading	**77**	51.0
	College	52	34.4
	Don't know	22	14.6
	Total	151	100.0

Table 1 shows that most participants were aware of Silver Diamine Fluoride, as 85.4% answered "Yes" when asked if they knew about SDF. Regarding the source of education, self-reading was the most commonly reported source, representing 51.0% of participants, followed by college education at 34.4%. This indicates that although awareness of SDF was high, much of the information was obtained through self-learning rather than formal education.

Table 2. Clinical Knowledge about Application, Mechanism, Drawbacks, and Application Protocol of SDF

Item	Response	Frequency (n)	Percentage (%)
Knowledge about possible drawbacks of SDF	Yes	80	53.0
	No	71	47.0
	Total	151	100.0
Application interval protocol of SDF	Single application	27	17.9
	Annual reapplication	7	4.6
	Six-month reapplication	78	51.7
	Don't know	39	25.8
	Total	151	100.0
	Anterior teeth	٧	4.6

Site of SDF application	Posterior teeth	٥٨	38.4
	Anterior teeth and Posterior teeth	86	57.0
	Total	151	100.0
Mechanism of action of SDF	Antimicrobial	47	31.1
	Remineralizing materials	81	53.6
	Don't know	23	15.2
	Total	151	100.0

Table 2 summarizes the clinical knowledge of dentists regarding SDF. More than half of the participants believed that SDF can be applied to both anterior and posterior teeth (57.0%). Regarding the mechanism of action, 53.6% identified SDF as a remineralizing material, while 31.1% selected its antimicrobial effect. In addition, 53.0% of participants were aware of the possible drawbacks of SDF. For the application interval protocol, the most common response was six-month reapplication, selected by 51.7% of participants. These findings suggest that dentists had a moderate level of clinical knowledge about SDF, but some gaps remained, especially regarding the correct protocol and mechanism of action.

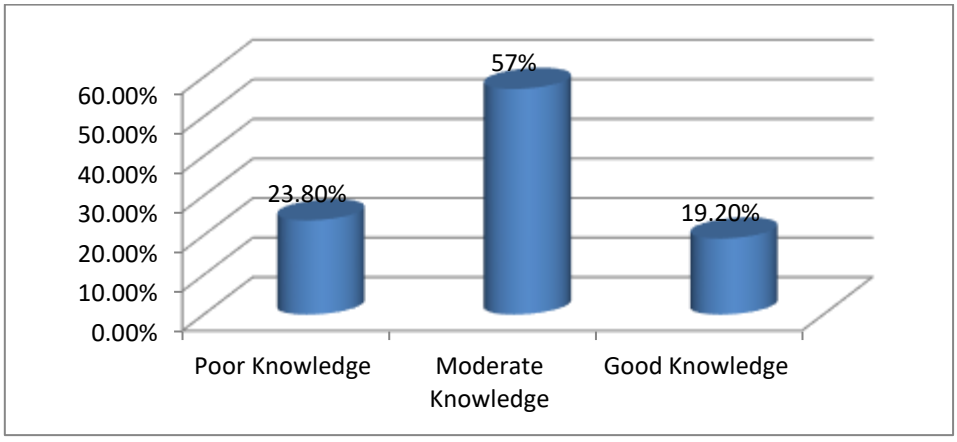

Figure 1: Overall Knowledge Level of Dentists about Silver Diamine Fluoride

Part II: Attitude of Dentists Toward Silver Diamine Fluoride

Table 3. Attitude and Overall Attitude Level of Dentists Toward SDF

Item	Response	Frequency (n)	Percentage (%)
SDF as an alternative to conventional restoration	Yes No Don't know	53 71 27	35.1 47.0 17.9
Use of SDF in children with behavioral issues	Agree Disagree	110 41	72.8 27.2
Use of SDF in medically fragile patients	Agree Disagree	103 48	68.2 31.8
Use of SDF in patients with severe dental anxiety	Agree Disagree	110 41 103	72.8 27.2 68.2
Use of SDF in non-esthetic primary teeth	Agree Disagree	122 29	31.8 80.8
Overall attitude level	Negative attitude (<50%) Moderate attitude (50–74%) Positive attitude (≥75%)	32 74 45	21.2 49.0 29.8

Table 3 summarizes dentists' attitudes toward Silver Diamine Fluoride. Regarding the use of SDF as an alternative to conventional restoration, the highest percentage of participants answered "No" (47.0%), while 35.1% answered "Yes" and 17.9% were uncertain. However, most dentists showed favorable attitudes toward using SDF in special clinical situations, including children with behavioral issues (73.5%), medically

fragile patients (72.8%), patients with severe dental anxiety (68.2%), and primary teeth when the lesion is not located in an esthetic zone (80.8%). Overall, nearly half of the participants demonstrated a moderate attitude toward SDF (49.0%), while 29.8% showed a positive attitude.

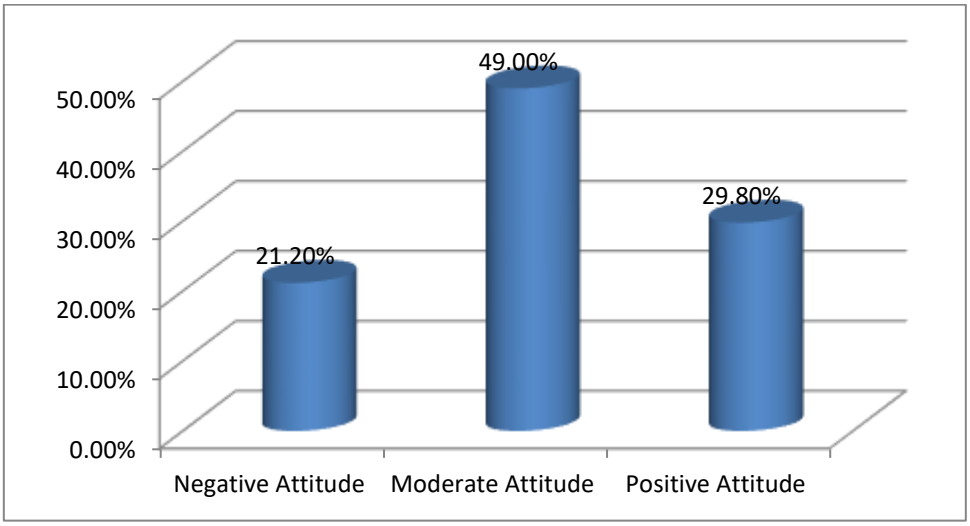

Figure 2: Overall Attitude Level of Dentists toward Silver Diamine Fluoride

Possible barrier	Frequency (n)	Percentage (%)
Does not restore tooth structure and function	44	29.1
Inadequate knowledge	51	33.8
Patient acceptance	56	37.1
Total	151	100.0

Table 4 shows the possible barriers to the use of Silver Diamine Fluoride. The most commonly reported barrier was patient acceptance, representing 37.1% of responses, followed by inadequate knowledge at 33.8%. In addition, 29.1% of participants reported that SDF does not restore tooth structure and function. These findings indicate that patient-related factors and insufficient knowledge may limit the clinical use of SDF among dentists.

Overall, the findings revealed that most dentists had a moderate level of knowledge and attitude toward Silver Diamine Fluoride. More than half of the participants demonstrated

moderate knowledge (57.0%), and nearly half showed a moderate attitude (49.0%). However, only 19.2% had good knowledge and 29.8% had a positive attitude toward SDF. These results indicate the need for improved educational programs, clinical training, and awareness campaigns to enhance dentists' knowledge, confidence, and clinical use of SDF.

DISCUSSION

Silver Diamine Fluoride (SDF) has become increasingly recognized as an important minimally invasive approach for the prevention and arrest of dental caries, particularly in pediatric dentistry and public health settings. Recent systematic reviews have reported that SDF is effective in arresting carious lesions in children and may represent a practical, low-cost, and non-invasive option, especially in low-resource settings [8,9]. These advantages make SDF particularly relevant in countries where access to conventional restorative dental care may be limited. In the present study, the majority of participating dentists reported that they were familiar with SDF, as 85.4% answered "Yes" when asked whether they knew what SDF is. However, the overall assessment showed that most participants had only a moderate level of knowledge, while a smaller proportion demonstrated good knowledge. This finding suggests that although general awareness of SDF exists among dentists, detailed knowledge regarding its indications, mechanism of action, application protocols, clinical limitations, and patient communication may still require improvement.This finding is consistent with recent studies conducted in different countries, which showed that dentists' knowledge and clinical use of SDF vary considerably despite generally positive attitudes toward its benefits [10-12]. A recent mixed-method study among dentists in Hong Kong reported that many dentists were aware of SDF, but clinical use was influenced by knowledge, training, patient acceptance, and confidence in case selection [13]. Similarly, a study among dentists in Riyadh, Saudi Arabia, found variability in knowledge, attitudes, and practices regarding SDF, emphasizing the need for further professional education and training [14].The present study also showed that more than half of the participants learned about SDF through self-reading rather than formal college education. This may indicate a gap in undergraduate and postgraduate dental curricula regarding SDF and minimally invasive caries management. Similar findings have been reported in recent studies, where insufficient formal training and lack of standardized clinical guidance were identified as important barriers to SDF adoption [15,16]. Therefore, integrating SDF-related theoretical and clinical training into dental curricula and continuing dental education programs may improve dentists' confidence and clinical decision-making.

Regarding the mechanism of action, many participants identified SDF mainly as a remineralizing material. Although this reflects partial understanding, the mechanism of SDF is broader and includes the antimicrobial effect of silver ions, remineralizing action of fluoride, inhibition of dentinal collagen degradation, and dentinal tubule occlusion. Recent reviews support that the clinical effectiveness of SDF is related to its combined antibacterial and remineralizing properties [17,18]. Therefore, improving dentists' understanding of the biological mechanism of SDF may help promote its appropriate clinical use.The findings also showed that slightly more than half of the participants were aware of the possible drawbacks of SDF. This is clinically important because black staining of arrested carious lesions remains one of the most commonly reported disadvantages of SDF and a major factor affecting patient and parent acceptance. Recent literature confirms that esthetic concerns, particularly black discoloration, are among the main barriers to SDF acceptance, especially when anterior teeth are involved [19,20]. Therefore, dentists should provide proper counseling and obtain informed consent before SDF application, explaining both the benefits and expected esthetic changes.

In the current study, patient acceptance was the most frequently reported barrier to SDF use. This finding agrees with recent qualitative and questionnaire-based studies showing that acceptance of SDF is strongly influenced by lesion location, esthetic expectations, and the explanation provided by the dentist [21,22]. A recent study from Iraq assessing parental acceptance of SDF also highlighted differences in acceptance between anterior and posterior teeth, confirming that esthetics plays a central role in treatment acceptance [23]. These findings support the need for improving communication strategies between dentists, patients, and parents.

The attitude findings of the present study showed that nearly half of the participants had a moderate attitude toward SDF, while less than one-third demonstrated a positive attitude. However, many dentists agreed that SDF could be useful in children with behavioral management problems, medically fragile patients, patients with severe dental anxiety, and primary teeth located outside the esthetic zone. This is consistent with contemporary recommendations that SDF may be particularly useful when conventional restorative treatment is difficult, delayed, or poorly tolerated [24]. SDF can reduce the need for drilling, local anesthesia, sedation, or general anesthesia in selected cases.A high percentage of participants agreed that SDF is a good treatment option for primary teeth when the lesion is not located in the esthetic zone. This finding is clinically reasonable because the main limitation of SDF is black staining, which is less problematic in posterior or non-esthetic areas. Recent studies have also shown that parents and clinicians are more likely to accept SDF when it is used in posterior teeth or when it helps avoid more invasive treatment [25,26].

Despite the advantages of SDF, a considerable proportion of participants did not consider it a complete alternative to conventional restorative treatment. This view is appropriate because SDF arrests caries progression but does not restore tooth anatomy, function, or esthetics. Therefore, SDF should be considered a caries-arresting and disease-control agent rather than a universal replacement for restorative treatment. It may be used as an interim treatment, part of a comprehensive caries management plan, or a public health intervention for high-risk populations.

The present findings are also comparable with a recent Iraqi study that investigated knowledge, attitudes, and barriers among Iraqi dental practitioners toward SDF use in children. That study reported that knowledge and clinical acceptance of SDF were affected by training, perceived barriers, and clinical confidence [27]. The similarity between the present findings and recent Iraqi data suggests that there is a continuing need to improve SDF-related education and clinical training among dental practitioners in Iraq.Overall, the findings of the present study indicate that dentists in Iraq generally have moderate knowledge and moderate attitudes toward SDF. Although many participants recognized its usefulness in children, medically fragile patients, anxious patients, and non-esthetic primary teeth, gaps remain in detailed knowledge, clinical confidence, and patient communication. Therefore, targeted educational programs, practical workshops, and evidence-based clinical guidelines are recommended to support the appropriate implementation of SDF in preventive and minimally invasive dental care.

CONCLUSION

Silver Diamine Fluoride (SDF) is a simple, minimally invasive, and cost-effective option for the prevention and management of dental caries, particularly in uncooperative children and patients who cannot tolerate conventional dental treatment. The present study showed that Iraqi dentists had a moderate level of knowledge and attitude toward SDF, while good knowledge and highly positive attitudes remained limited. Inadequate knowledge, limited clinical training, patient acceptance, and the inability of SDF to restore tooth structure and esthetics were identified as the main barriers to its routine use. Therefore, continuing education programs, hands-on training, and evidence-based guidelines are recommended to improve dentists' confidence and promote the appropriate clinical use of SDF in preventive and minimally invasive dental care.

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