Research Article

Knowledge, attitudes, and barriers of a cohort of Iraqi dental practitioners towards the use of silver diamine fluoride in children

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Abstract: Background: Silver diamine fluoride (SDF) has attracted increasing attention. since it is a conservative method that can prevent weakening of the tooth structure, postoperative pain, and the need for extensive restoration. This study aimed to investigate the knowledge, attitudes, and barriers of Iraqi dentists toward the use of SDF in children. Methods: In a cross-sectional study conducted among 406 Iraqi dentists, a Google form was used to collect data on their knowledge, attitudes and barriers to the use of SDF for children. The survey consisted of three sections: the first section collected demographic data from the participants, the second section focused on their knowledge and attitudes towards this material, and the third section identified possible barriers to its use. Statistical analysis was performed using Fisher's exact test and the chi-square with a significance level of 5%. Results: The research revealed that 61.58% of the participants knew about this material and their knowledge was significantly related to age, sex, and speciality. Scientific lectures, discussions, and workshops were the primary sources of information (33.25%). The majority (67.9%) agreed to use this material for caries arrest, with more than 60% expressing a positive attitude toward it as a viable alternative treatment for children with behavioural issues. The primary barrier to its use was the potential for permanent black staining (77.6%). Conclusions: Although not a common practice among dentists, most of the participants agreed that using this material to treat dental caries in children is a promising method, as it requires simple instruments and does not require special training.

Keywords: Attitude, children, dentists, knowledge, barriers, silver diamine fluoride.

Introduction

Childhood caries is a severe disease that affects many young children, especially those in underprivileged communities. Its incidence remains high in disadvantaged communities, where untreated cases among children are widespread. This phenomenon is attributable to two primary factors: dental caries treatment is inaccessible to paediatric patients or unaffordable [1] [2].

As part of the new global goals for dental health, minimal intervention dental procedures are recommended as alternative methods to manage dental caries. Instead of relying on aggressive treatments, cariostatic agents must be used to treat and arrest carious lesions. Silver diamine fluoride (SDF) has been shown to be an efficient and safe method of arresting dental caries, particularly in children. It is affordable, easy to use, and has well-marked advantages [1,3,4]. The evidence overwhelmingly supports the use of SDF in primary teeth, particularly for children with a high risk of dental caries, including those with intellectual or developmental disabilities[1]. It can also help prevent and arresting dental caries in adults with limited access to dental care or financial resources for transient pulpal and gingival irritation. Additionally, SDF can reduce teeth sensitivity [4]. However, the blackening effect of carious lesions, which is a commonly recognised disadvantage, should not overshadow its effectiveness in the treatment of dental caries [4] [5].

The conventional method for restoring teeth requires a procedure that involves local anaesthesia, rotary burs, and a highly skilled dentist [6] [7]. However, this may cause pain and discomfort, making patients reluctant to undergo treatment [8] [9]. On the contrary, SDF is a conservative method that can prevent the weakening of the tooth structure, minimise postoperative pain, and reduce the need for extensive restoration that can result from the conventional (invasive) method of caries removal. It can also preserve the vitality of a tooth and avoid the need for endodontic treatment or extraction [10]. Meanwhile, it is an advisable option for children with special healthcare needs, as it reduces the need for general anaesthesia and its side effects [11] [12]. It can also be a non-invasive method to successfully treat active carious posterior primary teeth in children [12] [13]. However, some barriers to its clinical use include the possibility of staining dental hard tissues and the need for frequent applications [14]. Therefore, some dentists are apprehensive about using it because it affects the aesthetic appearance of the tooth [5].

Some studies have reported that using 38% SDF twice a year can help arrest more than 80% of carious lesions [15,16]. It is also suggested that the elastic modulus and microhardness increase with the use of SDF[17]. On the other hand, care is needed during the application of SDF to prevent any contact of the material with pulpal or gingival tissue due to the potential irritation. Furthermore, SDF cannot arrest deep seated caries, so carious teeth with suspected pulp involvement should not be treated with it [15]. Children with a history of silver sensitivity should not be subjected to SDF treatment [14].

Currently, there is a shortage of literature exploring the knowledge, attitudes, and barriers of Iraqi dentists to the use of SDF in the treatment of dental caries in children. In light of this, the primary objective is to identify Iraqi dentists that employ SDF in children. The study aims to provide a data-driven baseline to improve the management of dental caries within the Iraqi dental health system. Furthermore, the result may contribute to the existing body of knowledge on the subject and potentially inform future policies and guidelines for dental professionals working in Iraq.

Materials and Methods

Study design, population, and ethical approval

To achieve the research goal, a custom online questionnaire was created and administered online between April 2022 and July 2022 to achieve the research goal. The study was granted ethical clearance in April 2022 and followed the Declaration of Helsinki [18], with the University of Baghdad College of Dentistry endorsing the investigation. The study is uniquely identified by reference code 545.

To invite participants to the study, the Iraqi Dental Association (IDA) provided a list of officially registered dentists in Iraq with active legal registration and an email address on file to invite them to participate in the study.

Sample size calculation

According to official records, there are approximately 6463 registered dentists in Iraq. To achieve a 5% error margin and a 95% confidence interval, the estimated sample size for this study was calculated using a formula from a previous survey conducted in Iraq (reference 19). The required information was obtained from the IDA. As a result, the study requires a sample size of 363 dentists.

Survey instrument and data collection

The study used a simple random sampling technique to collect samples from participants. Before starting the study, informed consent was obtained from participants online. A Google form was designed for participants to respond to a brief questionnaire. The questionnaire contained a quick overview of the research objectives and the researcher's identity. Participants were assured that their data would be anonymous and used solely for academic purposes. The questionnaire was based on a previously validated and published questionnaire, with modifications made to align with the goals of the current study, subject to the author's approval [20] [24].

The questionnaire was distributed through social media and email platforms, and participants received a reminder a few days after the initial distribution. The questionnaire consisted of three sections and a total of 20 questions. The first segment sought to collect demographic data from participants, including but not limited to age, gender, professional status, speciality, workplace area, city, and graduation year. The second section consisted of twelve multiple-choice questions designed to estimate participants' knowledge of SDF. It included a question explicitly designed for teachers to evaluate whether they had passed on SDF-related information to their students. The final section focused on identifying potential barriers to SDF usage.

Data Analysis

The present study used IBM SPSS Statistics software version 24.0 (SPSS Inc., Chicago, USA) to perform tabulation and data analysis. Descriptive statistics, specifically frequency and percentage, were used to describe demographic variables. Fisher's exact and chi-square tests were performed to establish the correlation between the use of SDF and dentists' characteristics. Statistical significance was set at 5%, with a 95% confidence interval.

Results

The study surveyed 406 dentists who answered a questionnaire thoroughly. Of these, 194 dentists (47.78%) were in the 20-30 year age group, 33.5% were between the ages of 31-40, and 18.72% were over 40 years old. Regarding gender, 137 (33.74%) of the respondents were male, while 269 (66.26%) were female. The academic respondents were 31.03% and those who worked in clinics in the governorate centres were 80.79%. Of these, 60.84% were located in the capital city of Baghdad. Furthermore, 42.8% of the respondents specialised in paediatric and preventive dentistry, 17.6% with other specialities, while 39.6% were general dentists. These details are based on Table 1.

To evaluate the knowledge of Iraqi dentists of SDF, the questionnaire started with a question: "Have you ever heard about silver diamine fluoride (SDF)?" Of the total sample, 61.58% of the respondents had heard about SDF, while 38.42% reported that they had not heard about this product. Among the 126 academics who participated in this survey, 76 (30.40%) had heard of SDF and only 49 (64.5%) of them taught SDF to their students in both theoretical and clinical classes. The study found a significant difference between the question and the sociodemographic details of Iraqi dentists with some variables, such as age, sex, and speciality of dentists. However, no significant association was found with the other variables.

Table 1. Relationship of sociodemographic details of Iraqi dentists with knowledge of silver diamine fluoride (SDF).

Variables	*Q1: Have you ever heard of SDF?*		**Total**	*p-value*
	Yes (No.=250)	*No (No.=156)*	**No. (%)**	
	No. (%)	**No. (%)**		
Age (Years)				
20-30	124 (49.60)	70 (44.87)	194 (47.78)	
31-40	83 (33.20)	53 (33.97)	136 (33..5)	0.002*
> 40	43 (17.20)	33 (21.15)	76 (18.72)	
Sex				
Males	70 (28)	67 (42.95)	137 (33.74)	0.002*
Females	180 (72)	89 (57.05)	269 (66.26)	
Employment status				
Academic	76 (30.40)	50 (32.05)	126 (31.03)	
Public only	78 (31.20)	35 (22.44)	113 (27.83)	0.157
Private only	32 (12.80)	18 (11.54)	50 (12.32)	
Public and Private	64 (25.60)	53 (33.97)	117 (28.82)	
Specialty				
General dentists	99 (39.60)	69 (44.23)	168 (41.38)	
Pediatric / Preventive	107 (42.80)	14 (8.98)	121 (29.80)	0.000*
Others	44 (17.6)	73 (46.79)	117 (64.39)	
Graduation year				
≤2014	121 (48.4)	83 (53.21)	204 (46.79)	
>2014	129 (51.6)	73 (46.79)	202 (53.20)	0.346

* Significant difference using the Chi-square test.

Table 2 presents data on the use of SDF in clinical practice. According to the survey, the majority of the respondents (33.25%) relied on scientific lectures, discussions and workshops attended after graduation as their main source of information on the application of SDF. Academic teaching was also cited as a significant source of information (28.33%) for the respondents.

The survey participants were asked about the types of lesions for which SDF is indicated. The results showed that 38.18% of the respondents believed that SDF could be used for carious enamel and dentin lesions, while 34.24% suggested that it could be used for teeth regardless of the lesions. Most of the respondents (65.76%) agreed that SDF could be applied to both primary and permanent dentition.

Regarding the location of the lesions, the survey participants were asked about the use of SDF for the anterior and posterior teeth. The results showed that 71.43% of the respondents indicated using SDF for the anterior and posterior teeth, while only 25.37% reported using SDF for the posterior teeth.

For the question 'In your opinion, which of the following choices is an advantage of using SDF', 67.98% (n = 276) got the correct answer (caries arrest). Meanwhile, when dentists were asked about the significant

disadvantage of SDF use, 66.26% (n = 269) chose the correct option (tooth staining). Most of the participants (68.72%) agreed that SDF does not require local anaesthesia.

When respondents were asked about the SDF application in a year, 38.71% had no idea about the SDF application protocol. Meanwhile, the response of 29.03% of the total sample was 'two times a year', which is the recommended application interval.

Table 2. Knowledge of Iraqi dentists about the treatment with silver diamine fluoride (SDF).

Questions	Total N (406)	%
The source of your knowledge		
In your college	115	28.33
Attendance of scientific lectures, discussions, and workshops after graduation.	135	33.25
You did not hear about it at all	156	38.42
The types of lesions that SDF can be used for		
Enamel carious lesion only	94	23.15
Dentin carious lesion only	18	4.43
Carious lesions in enamel and dentine carious lesions	155	38.18
It can be used for teeth with or without lesion	139	34.24
Type of dentition that the SDF can be used for		
Primary teeth only	110	27.09
Permanent teeth only	29	7.14
Both primary and permanent teeth	267	65.76
Type of teeth that the SDF can be used for		
Anterior teeth only	13	3.20
Posterior teeth only	103	25.37
Both anterior and posterior teeth	290	71.43
In your opinion, which one of the following is an advantage to using SDF		
Fluoride release	107	26.35
Caries arrestment	276	67.98
Easthetically pleasant	3	0.74
Mummifications	20	4.93
In your opinion, which one of the following is a disadvantage to using the SDF		
Staining of the tooth	269	66.26
Irritation to the pulp	32	7.88
Toxicity	105	25.86
The use of SDF does not require local anaesthesia.		
Yes	279	68.72
No	39	9.61
I do not know	87	21.43
How many applications do you think it will be effective when you use SDF?		
Single application only	95	23.40
Once a year	36	8.87
Twice a year	118	29.06
I don't know	157	38.67

Table 3 shows the attitude of Iraqi dentists towards SDF. About 35% of the respondents agreed that SDF is an alternative to the more conventional drilling method. More than half of the participants agreed that SDF is an effective treatment for primary tooth lesions but not in easthetic areas. At the same time, 45.57% of the respondents believed that SDF is an appropriate treatment option for permanent tooth lesions in non-easthetic areas.

Most of the respondents agreed that SDF is a viable alternative treatment for children with behavioural problems (65.52%), people who cannot currently afford dental restorations (54.93%) and medically compromised patients (63.55%). Furthermore, 62.31% of the respondents preferred the use of SDF for patients with severe dental anxiety.

Table 3. Dentist attitude about silver diamine fluoride (SDF) treatment.

The Question	Responses		
	Agree (%)	Disagree (%)	Not sure (%)
The use of SDF is an alternative method to the drilling method	142 (34.98)	101 (24.87)	163 (40.15)
SDF is a good treatment when it is used to treat lesions			
in the primary teeth when the lesions are not found in the aesthetic area	228 (56.16)	46 (11.33)	132 (32.51)
in permanent teeth when the lesions are not found in the aesthetic area	185 (45.57)	67 (16.50)	154 (37.93)
SDF can be used as an alternative treatment			
When restorations are required in children with behavioural problems	266 (65.52)	40 (9.85)	100 (24.63)
When the patient needs restoration later but cannot afford it now	223 (54.93)	61 (15.02)	122 (30.05)
When the patient is medically compromised	258 (63.55)	40 (9.85)	108 (26.60)
When the patient has severe dental anxiety	253 (62.31)	36 (8.87)	117 (28.82)
When the patient is undergoing or has recently undergone radiation therapy or chemotherapy.	173 (42.61)	47 (11.58)	186 (45.81)
When the patient is under bisphosphonate medications.	112 (27.95)	53 (13.05)	241 (59.36)
For a patient who cannot receive conventional dental treatment and receive general anaesthesia.	252 (62.07)	27 (6.65)	127 (31.28)
For a patient with microstomia, there is difficulty accessing the lesions that require dental treatment.	191 (47.04)	49 (12.07)	166 (40.89)

Furthermore, 42.61% of the participants agreed that SDF serves as a viable treatment method for people who have recently undergone radiation therapy or chemotherapy or have recently undergone it. Likewise, 27.95% of the respondents believed that SDF can be used for patients undergoing bisphosphonate treatment. Furthermore, 34.24% of the respondents agreed that SDF treatment is preferable for patients who require general anaesthesia. Lastly, 47.04% of the respondents agreed that SDF is a suitable treatment option for patients with microstomia and to access lesions that require dental treatment in complex locations.

The significant barriers to the use of SDF among most Iraqi dentists who heard about it were the following: 'the permanent black tooth stain that appeared after treatment' (77.6%), 'SDF does not restore tooth shape and function if used alone (without restoration after)' (72.4%) and 'patient / parental acceptance' (71.2%). The results are presented in Table 4.

Table 4. Barriers to the use of silver diamine fluoride.

Barriers to using silver diamine fluoride (SDF)		*Heard about SDF*				*p-value**
		Yes(250)		*No(156)*		
		N	*%*	*N*	*%*	
Patient acceptance/ Parental acceptance	**Yes**	178	71.2	57	36.54	0.000
	No	47	18.8	16	10.26	
	I do not know	25	10	83	53.20	
Permanent black tooth staining after treatment	**Yes**	194	77.6	58	37.18	0.000
	No	32	12.8	15	9.62	
	I do not know	24	9.6	83	53.20	
It does not restore the shape and function if it is used alone (without a restoration after it	**Yes**	181	72.4	58	37.18	0.000
	No	39	15.6	17	10.90	
	I do not know	30	12	81	51.92	
Inadequate training	**Yes**	128	51.2	55	35.26	0.000
	No	95	38	22	14.10	
	I do not know	27	10.8	79	50.64	
Inadequate scientific Knowledge	**Yes**	136	54.4	76	48.72	0.000
	No	85	34	9	5.77	
	I do not know	29	11.6	71	45.51	
Cost of the material	**Yes**	116	46.4	38	24.36	0.000
	No	89	35.6	23	14.74	
	I do not know	45	18	95	60.90	
Satisfaction of the patient	**Yes**	156	62.4	51	32.69	0.000
	No	41	16.4	13	8.33	
	I do not know	53	21.2	92	58.97	

* Significant difference using the Chi-square test.

Discussion

The study aimed to evaluate the knowledge, attitudes, and barriers of Iraqi dental practitioners to the use of SDF in children. More than 61% about the participants knew of SDF and its benefits, indicating increasing knowledge among Iraqi dental practitioners. The results of this survey suggest that two-thirds of Iraqi dentists have good knowledge regarding the use of SDF in the management of dental caries management. This highlights the need for more teaching initiatives within dental schools and dental organisations concerning the use of SDF in young patients, particularly those who exhibit a lack of cooperation or reside in rural areas where dental services are inaccessible.

Furthermore, the study shows that the level of awareness of SDF among dentists was significantly associated with their age, sex and specialty. Specifically, dentists specialising in peadiatric and preventive dentistry demonstrated a greater familiarity with SDF suggesting the potential for greater adoption in Iraq, which was consistent with recent research [21]. This may be attributed to the fact that the main clinical indications for the use of SDF are the arrest of dental caries and the prevention of newly formed carious pits and fissure lesions [22] [23]. These findings provide valuable information on the current status of SDF knowledge among Iraqi dentists and underscore the need for further research and education on this promising technique. In general, this study represents a significant step towards achieving better oral health outcomes in Iraq.

Although most dentists (65.76%) were aware of the use of SDF in primary and permanent teeth, only 28.33% of respondents cited their undergraduate studies as a source of knowledge. In this study, more than half of the academic participants who heard about SDF (49 out of 76) taught SDF to their students in both theoretical and clinical classes. The study finding that SDF can prevent caries is consistent with previous research [22] [24]. However, only 29.03% of the respondents were aware of the recommended frequency of application of SDF (two times a year) [15] [16] [25], which can lead to tooth staining (reported as the main disadvantage by 66.26% of the respondents) [26]. Iraqi dentists were found to use SDF in non-asthetic areas, in line with previous research [13] [27].

In accordance with the guidelines of the American Academy of Paediatric Dentistry [28], more than 60% of the participants in this study agreed that SDF is an excellent technique to treat children with behavioural problems. In addition, it is a good alternative treatment for patients with medical problems, severe dental anxiety, and those who cannot receive conventional dental treatment or general anaesthesia for treatment. These results are consistent with the results of other studies [11] [16] [24] [25] [27] [29]. These findings demonstrate the potential of SDF treatment to offer a safe, affordable, and effective alternative to traditional drilling methods. Thus, it could serve as a valuable addition to the dentist's arsenal, providing clinicians with a versatile treatment option for a diverse range of patients.

The primary barriers to the widespread use of SDF among most Iraqi dentists who are aware of it are its potential for permanent black tooth staining, the inability to restore tooth shape and function if it is used alone without restoration afterwards, and patient/parental acceptance. These findings followed those previously reported [20] [21][28-30].

However, parental acceptance of the SDF staining effect varies widely among Iraqi parents [31]. The most important factors that influence their acceptance are the attitude of the child and the desire to avoid extensive dental and behavioural treatment, such as general anaesthesia or sedation [15] [31].

Limitations of the study

This study has limitations due to dentist responses in real-life scenarios that do not accurately reflect their attitudes and their lack of data on prolonged use and clinical experience. More research with a larger sample size is necessary for more conclusive results. Future research should identify the source of vulnerabilities in current knowledge of Iraqi dentists, including employment experience and teaching practices, to enhance their knowledge, skills, and practices and improve the overall quality of dental care in the country.

Conclusion

Most Iraqi dentists had a good understanding of SDF and believed it was a practical, affordable, and easy-to-use treatment option for dental caries. However, concerns about black tooth staining were identified as a significant barrier to its use. Despite the challenges, the study highlighted the potential of SDF to transform dental caries management in Iraq. The study recommended raising awareness of SDF and promoting its teaching in undergraduate courses to improve knowledge and attitudes among Iraqi dentists.

Conflict of interest: The author declares that there was no conflict of interest.

Authors' contributions

AHMJ; study conception and design of the study and data collection. AHMJ; Methodology. AHMJ and OAB; statistical analysis and interpretation of results. AHMJ; and OAB original draught manuscript preparation; writing & editing. All authors reviewed the results and approved the final version of the manuscript to be published.

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Data Availability statement: The dataset used in the current study is available upon reasonable request.

Ethical approval:

The protocol was approved by the research ethics committee at the College of Dentistry, University of Baghdad (Ref. number: 545, 17 April 2022).

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المعرفة والمواقف والتصورات لمجموعة من اطباء الأسنان العراقيين تجاه استخدام فلوريد ديامين الفضة عند الأطفال

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المستخلص:

خلفية: لقد اجتذب فلوريد ديامين الفضة (**SDF**) اهتمامًا متزايدًا لأنه طريقة محافظة يمكن أن تمنع إضعاف بنية الأسنان، والألم بعد العملية الجراحية، والحاجة إلى ترميم واسع النطاق. هدفت هذه الدراسة إلى تحديد الاستراتيجيات الفعالة لتحسين العناية بالأسنان للأطفال من خلال التحقق من معرفة أطباء الأسنان العراقيين ومواقفهم وتصوراتهم تجاه استخدام فلوريد ديامين الفضة لدى الأطفال. الطرق: في دراسة مقطعية أجريت على 406 من أطباء الأسنان العراقيين، تم استخدام نموذج **Google** لجمع بيانات حول معارفهم ومواقفهم والعوائق التي تحول دون استخدام فلوريد ديامين الفضة للأطفال. يتكون الاستطلاع من ثلاثة أقسام: القسم الأول جمع بيانات عن التركيبة السكانية للمشاركين، وركز القسم الثاني على فهمهم لـهذه المادة، وحدد القسم الثالث العوائق المحتملة لاستخدامه. تم إجراء التحليل الإحصائي باستخدام اختبار فيشر الدقيق ومربع كاي بمستوى دلالة 5٪. كشف البحث أن 61.58% من المشاركين كانوا على دراية بـ هذه المادة، وكانت معرفتهم مرتبطة بشكل كبير بالعمر والجنس والتخصص. وكانت المحاضرات العلمية والمناقشات وورش العمل هي المصادر الأساسية للمعلومات (33.25%). وافقت الأغلبية (67.9٪) على استخدام فلوريد ديامين الفضة لوقف التسوس، مع تعبير أكثر من 60٪ عن موقف إيجابي تجاهه كعلاج بديل قابل للتطبيق للأطفال الذين يعانون من مشاكل سلوكية. كان العائق الأساسي أمام استخدام هذه المادة هو الأسوداد الدائم الذي ينتج عنها(77.6٪). الاستنتاجات: على الرغم من أنها ليست ممارسة شائعة بين اطباء الأسنان، إلا أن معظم المشاركين اتفقوا على أن استخدام فلوريد ديامين الفضة للسيطرة تسوس الأسنان لدى الأطفال هو طريقة واعدة، لأنها تتطلب أدوات بسيطة ولا تتطلب تدريبًا خاصًا.