Dental practitioners' knowledge and attitude regarding the use of silver diamine fluoride for the management of dental caries

Rasmia M Huew[1*], Sukaina B Elshebani[2], Rogaia B Alaskandrani[2], Marwa A Abozed[2], Najway Ahmed[3]

[1] Associate professor, Department of Pediatric Dentistry, Faculty of Dentistry, University of Benghazi (UOB), Benghazi, Libya

[2] Lecturer, Department of Pediatric Dentistry, Faculty of Dentistry, University of Benghazi (UOB), Benghazi, Libya

[3] Department of Community Medicine, Benghazi Medical Center, Benghazi, Libya

Correspondence Author: Rasmia M Huew

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Abstract

Aim: To evaluate the knowledge and attitude among Libyan dental practitioners in Benghazi pertaining to the use of Silver Diamine Fluoride (SDF).

Materials and Methods: This was a cross-sectional study in which the data was collected via a validated and published questionnaire. The study was conducted using an online and a papered questionnaire. A random sampling of Libyan dental practitioners filled out a 3-section Likert-scale questionnaire including multiple questions determining demographic data, knowledge, attitude, SDF's potential future use, and actual use of SDF in dental practitioner's own practiced life.

Results: A total of 204 Libyan dental practitioners working in Benghazi public hospitals completed the survey. Their ages ranged from 20 to 59, the age group 20–30 years, representing 87 (43%), followed by the age group 30–40 representing 64 (31%). Gender-wise distribution revealed male number 54 (27%) almost third of female number 149 (73%). Almost half of participants were general dentists 98 (48%). When asked about their opinion on SDF usage, the majority of the participants agreed that SDF could be used to arrest cavitated lesions (69.5%), to arrest non-cavitated lesions (70%), should be placed under all restoration (65.9%) and should be placed under all restoration at caries risk patients (76.8%).

Conclusion: The knowledge and attitude of dental practitioners in Libya regarding SDF was evaluated and as such the aim of this study was accomplished. However, based on our findings, more studies are needed to assess the SDF's acceptance, implementation, and the difficulty of its adoption due to the lack of available data on its use.

Keywords: SDF, Caries, Dental practitioners, Knowledge, Attitude

Introduction

Dental caries is a multifactorial disease that can harm both primary and permanent teeth [1]. The prevalence of dental caries was the highest among all conditions of Global Burden of Disease 2015 [2]. Although the oral health is improved over the past years, dental caries is the most common oral disease in children and adults in developed and developing countries and is the main cause of loss of teeth in children. Dental caries estimation is alarming in all developing countries both primary and permanent dentitions. The percentage is estimated to be higher in developing countries compared to their developed counterparts [3, 4]. Although the prevalence of dental caries has declined in developed countries during the last 30 years, it remains a significant dental disease and a major public health challenge in children and adults [4]. Despite the fact that dental caries is preventable, it continues to be a major public health concern. Significant proportions of children and adults are still affected by caries in developing countries and it is also still increasing in many of these countries. In Egypt, for example, about 74% of children had caries [5], and in Saudi Arabia 78% of children had caries [6]. In Libya, the mean DMFT and DMFS indices in permanent teeth were 1.68 and 2.39 with the prevalence of dental caries 57.8% among Libyan school children, and the high level of untreated caries is a cause for concern, representing a high unmet treatment need [7]. Also, in more recent Libyan studies, the prevalence of caries in permanent teeth was 45% and the DMFT index was 1.80[8] and the overall caries experience in primary teeth was found to be high among school children in Benghazi (83.5%, mean dmft 3.3) [9]. Dental caries is considered one of the most prevalent chronic dental diseases. Generally, dental caries is treated through prevention or restoration. Non-restorative caries management allows sustainable caries control through controlling a bacterial infection and the remineralization of teeth. One of the lately advertised preventive materials for preventing the progression of dental caries is silver diamine fluoride (SDF). It is anticipated that the adaptation of SDF usage will be more widespread in the future, especially among children. SDF treatment is a typical example of non-restorative caries treatment. The usage of SDF is one of the recent conservative preventive procedures which focuses on inhibiting caries progression [10, 11] reasonably, prevention is more effective. It is confirmed to be non-invasive and cost-effective. Besides, prevention is simple and economy, while treatment is expensive and sometimes complex and it has proven to have success rate in dental caries prevention [12]. SDF was first discovered in Japan in 1970[11]. It is used to control caries, arrest root caries, prevent fissure caries and secondary

caries, and remineralise hypomineralised teeth, and it was not exposed much to other parts of the world. However, it has been lately approved by the Food and Drug Administration (FDA) in 2014 as an agent to treat tooth hypersensitivity and cavity-arrestment [13]. SDF is commonly available as a 38% solution containing 253,900 ppm silver and 44,800 ppm fluoride ions [14]. Sliver is antimicrobial and inhibits the growth of cariogenic biofilm. Fluoride promotes remineralization and inhibits the demineralization of teeth [15]. It has been stated that the use of 38% SDF twice yearly is recommended for obtaining the maximum benefits [16]. In 2021, the World Health Organization included SDF as an essential medicine that is effective and safe for adults and children patients [17]. SDF is a non-invasive treatment for dental caries management and no dental drill being needed in order to place restorative material, without pain and discomfort and also it is easy to use and handle, less expensive than restorative treatment and time efficient [18, 19]. In addition, placing SDF in deeply cavitated teeth can preserve the pulp vitality and prevent the need for a root canal treatment or extraction [20]. Furthermore, it could save time and effort for the dental staff and parents and it is as well considered to be a useful method to treat uncooperative patients, also, it can also be used to treat young children who are too young to accept conservative restorative management in a dental chair. In addition, it can be used to treat older adults, and people with special needs who are unable to collaborate with dental management. Besides, usage of SDF is better than having the child to undertake treatment under general anesthesia in the extreme cases. SDF treatment makes it possible to avoid conventional treatments such as tooth filling or extractions in child patients who need behavioral or medical management. As well, SDF has many other uses and benefits; it can be used in arresting and preventing root dental caries in adults with high caries risk [21, 22]. Also, it was approved that SDF can be used in primary and permanent teeth in children with high caries risk as well as can be used with children with disabilities. Furthermore, SDF can be used to reduce teeth sensitivity [21, 22]. About the cost of SDF, several issues should be taken into consideration, the low cost of the SDF, and the short time of application for the dentists as well as for the parents, also the durability of the treatment or the disease-free years [23]. Rosenblatt *et al*., called SDF a silver-fluoride bullet for caries treatment because SDF is a safe, effective, efficient and equitable caries control agent [24].

Anyway, the disadvantage of SDF is the esthetic outcome that manifests as a black stain on arrested carious teeth; it stains the enamel and dentin with a dark stain [21]. To overcome this limitation, a manufacturer recommends a two-step procedure using potassium iodide to reduce staining under restorations. The potassium iodide management is used if the tooth is restored, often with a sandwich restoration. Besides temporary tattoo to skin though not causing any pain, cannot be washed away, and it takes a long time for it to be removed. It may be resolved about 2 weeks due to skin exfoliation and it also stains clothes and clean surfaces. Also, the treatment with SDF does not repair normal tooth anatomy and function, if it is not followed by a restoration. In addition, SDF has an unpleasant metallic taste. However, application of fluoride varnish on the top of the SDF may mask the unpleasant taste of SDF and using of a rubber dam, or protect the gingiva with Vaseline or cocoa butter. Anyway, SDF's benefits are much more than its weaknesses.

Nowadays, uses of SDF for treatment dental caries in both primary and permanent teeth are approved. Several studies reported that the effectiveness of SDF for dental caries treatment is higher than other materials, and it is an effective cariostatic agent for arresting caries [15, 21]. Hence, the accessibility of a safe, effective, and efficient caries preventive material like SDF appears to meet the criteria of the WHO for 21st century medical care [17]. It is expected that the adaptation of SDF usage will be more prevalent in the future, especially among children. There has been an increase scientific study on SDF, which has been translated into clinical practice to improve the dental care. Moreover, SDF has gained approval in dental research and clinical work around the world in recent years [25] and majority of the studies showed high awareness of the existence of SDF and its use in dental field. Despite that, its use is still not common in dentistry and is not yet widely adopted in Libya. There is lack of studies done about SDF material in Libya, and there is no study conducted, up to my knowledge, assessing the knowledge and attitude toward SDF among Libyan dentists. Therefore, the aim of this study was to evaluate the knowledge and attitudes about SDF Libyan dental practitioners in Benghazi.

Materials and methods

Ethical approval was obtained from the research ethical committee (number 0122) of University of Benghazi. In addition to, online informed consent was obtained, since an online agreement button (Yes or No) to participate in the questionnaire was available, and participants who agree to informed consent were directed to the questionnaire. A link to the questionnaire was distributed in English language via email and social media platforms. Informed written consents were obtained from the participants who were given papered questionnaires. To choose the sample size of Libyan dental practitioners, a straightforward random selection method was taken into consideration. Dental practitioners in Benghazi who used social media or emails and worked in public hospitals made up the sampling size. The purpose of the study was clarified to the participants, and they were assured that the data will be confidential and will be used for professional cause only which includes this study. The questionnaire was adopted from a previously validated and published study done among American Pediatric dentists [26]. The questionnaire included three parts of questions with a multiple-choice style with Likert scale. The first section required demographic details, including sex, age group and specialty. The second section was designed to estimate the general awareness of the participants regarding of SDF, to measure their understanding and opinions on the SDF's use and to address their knowledge and attitudes towards SDF. Lastly, participants were asked about the future usage of SDF.

The data were imported and analyzed using Statistical Package for the Social Sciences (SPSS version 22.0) for windows.

Descriptive statistics were computed to provide an overview of responses using frequencies and percentages, chi-square tests, and logistic regression were used to examine the data.

Results

The study included 204 Libyan dental practitioners working in Benghazi public hospitals. Our study was a cross-sectional study conducted using questionnaire. The demographic information was gender, age group and specialty (Table 1). Gender-wise distribution revealed male number 54 (27%) almost third of female number 149 (73%). Their ages ranged from 20 to 59 years (Figure 1).

Table 1: Characteristic of Libyan dental practitioners participating in the questionnaire regarding SDF

Characteristics		Number (N)	Percentage (%)
Gender	Male	54	27
	Female	149	73
Age group	20-30	87	43
	30-40	64	31
	40-50	45	22
	50-59	8	4
Specialty	General dentist	98	48
	Resident	57	27
	Specialist	36	18
	Consultant	13	6

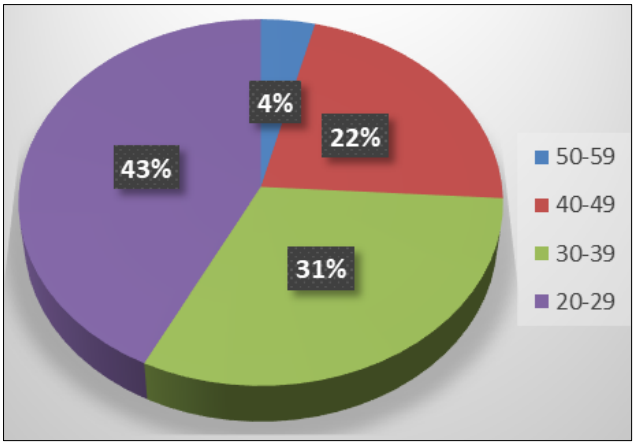

Fig 1: Age groups and percentages from total number 204 Libyan dental practitioners participating in the survey

Table 2: Responses of participating libyan dental practitioners regarding their SDF knowledge

How much do you agree/disagree with the following statements?	Strongly agree		Agree		Neutral		Disagree		Strongly disagree	
	N	%	N	%	N	%	N	%	N	%
SDF can be used to arrest non-cavitated lesion	9	33%	10	37%	3	11%	3	11%	2	7%
SDF can be used to arrest cavitated lesions	5	18.5%	14	51%	4	14.8%	2	7%	2	7%
SDF should be placed prior to all restorations	7	25.9%	11	40%	5	18.5%	3	11%	1	3.7%
SDF should be placed prior to all restorations at caries risk patients	4	14.8%	17	62%	2	7%	3	11%	1	3.7%

Note: The numbers in this table were rounded.

Table 2 illustrates responses of participating Libyan dental practitioners about their SDF knowledge. The dental practitioners among those who have general knowledge on SDF were asked about their understanding and opinion regarding SDF. When dental practitioners were asked if SDF should be used to arrest cavitated lesions; more than half of the sample (69.3%); stated that agreed (51%) and strongly agreed (18.5%). When participants were asked if SDF should be used to arrest non-cavitated lesions, approximately (70%); 37% of them stated that they agreed and 33% strongly agreed, when participants were asked if SDF should be placed prior to all restoration, of the sample (65.9%); 40% of them stated that they agreed and 25.9% strongly agreed. When dentists were asked if SDF should be placed prior to all restoration at caries risk patients, high percentage (76.8%) of the participants stated that they agreed (62%) and strongly agreed (14.8%).

Figure 2 illustrates the number of participating regarding their SDF Knowledge and awareness level. When asked, “Have you heard about SDF?” 13.3%, (n=27) of the participants were aware and have knowledge of this material, and the majority (n=117. 86.7%) who did not. However, when asked “have you used SDF?” all of the participating dental practitioners had never used SDF neither to prevent nor to arrest dental caries. Regarding SDF education, when they were asked from where they get their education about SDF, 100% of the respondents reported they were not at all educated about SDF in classroom

settings and 97% were not educated in clinical settings in dental school. Anyway, when they were asked if SDF can be used as alternative treatment for individuals with behavioral problems or medical issues, majority agreed and accepted it as a good alternative treatment for those with behavioral problems or medical problems. When they were asked, "do you expect your future usage of SDF will increase" they are very interested in this material, and they are planning to use it in the future.

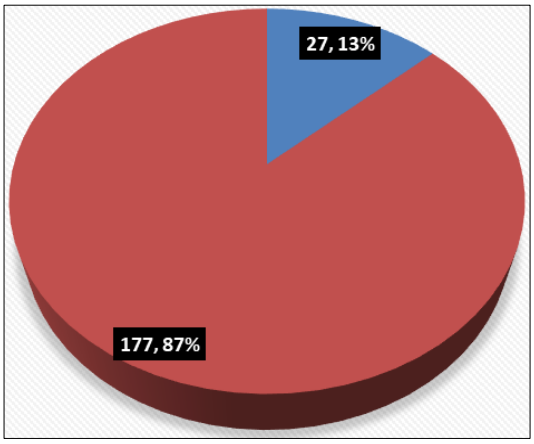

Fig 2: Number and percentages of Libyan dentists towards their SDF knowledge (n=27, 13.3% of the participants were aware of SDF, n=177, 86.7% were not aware)

Discussion

Silver diamine fluoride (SDF) has drawn a lot of interest as a non-invasive, affordable, and simple-to-apply treatment for dental caries, especially in kids and older people. A minimally invasive management to arrest caries is by use of 38% SDF. As well its ability to arrest decay, SDF is preferred by its inexpensiveness. Several studies reported that the application of SDF arrests or stops the progression of dental caries in a high percentage of cases and it has been approved as an appropriate substitute for caries treatment [27, 28]. The World Health Organization included SDF as an important materiel that is effective and safe for adults and children patients for caries arrestment [17]. According to the American Dental Association (ADA) guidelines, SDF material is recommended to be used to arrest advanced cavitated lesions in primary teeth. Also, it used to arrest occlusal carious lesions in permanent teeth [29]. Additionally, the American Academy of Pediatric Dentistry (AAPD) recommended SDF usage and adopted a policy and guideline supporting its use to treat caries in primary teeth as part of a comprehensive cavity-management program [23]. Traditional dental treatment for dental caries is not accessible, available or inexpensive in many populations. Using SDF in dental service can be a practical strategy for caries treatment. The usage of SDF is one such non-invasive method to treat dental caries either at the early stage or to treat a cavitated lesion, preventing more damage to tooth structure. Its technique requires a very short time application of economical materials [23].

However, to our knowledge, scarce studies have discussed SDF material in Libya and none of which focused on assessing SDF knowledge and attitude among Libyan dentists in Benghazi. Therefore, our research was a cross-sectional based questionnaire study conducted to evaluate knowledge and attitude of Libyan dental practitioners in Benghazi. This study included Libyan dental practitioners working in Benghazi public hospitals. Responses were received from 204 participants. Their ages were between 20 to 59 years. The majority was under 30 year of age; this may be because younger age group is more interested and comfortable with an online survey. Though, it is important to note that the gender was addressed by male number almost third of female number. When the participants were asked the questions" Have you heard about SDF?", if they have general knowledge regarding SDF, only 13.3% of the participants were aware and have general knowledge regarding SDF material uses while 86.7% of participating were not aware of the SDF. Moreover, when the participants were asked if they have used SDF before, all of the participating dental practitioners had never used SDF neither to prevent nor to arrest dental caries. Unfortunately, this only indicates that there is a lack of awareness in using SDF even among the dentists who stated that they have knowledge towards SDF. Knowledge of SDF has significant associations with the use of SDF. There is lack experience with the usage of SDF. But, the bright side that they are very interested in this material, and they are planning to use it in the future. In spite of the increasing evidence on its advantages, the use of SDF in the dentistry is not yet generally adopted in Libya. SDF material has lately been permitted in Libya; therefore, its usage among the Libyan dental community in Benghazi was unknown. Anyway, regarding SDF education, 100% of the participants reported they had received no instruction or education whatsoever in academic settings about SDF and 97% of them had received no instruction in clinical settings in dental school. However, this outcome is not unexpected given that SDF has been recently approved by the Food and Drug Administration (FDA) in 2014 [13]. Also, the WHO [17] newly included SDF as an essential material that is effective and safe for adults and children patients in 2021. Consequently, the knowledge of SDF usage was comparatively low, and several responses were not consistent with practical approval. This could be due to their unfamiliarity and inadequate educational skills with SDF. Although, the respondents do not have a positive attitude toward the use of SDF, they recognize it as a viable alternative treatment for people with behavioral difficulties or medical conditions.

The findings of our study, general knowledge regarding SDF material (13.3%), was in disagreement with that found in other studies; it was lower than (33%) of dental practitioners use SDF [30], lower than the one (45%) [31], and lower than the figure 54.6% [32]. Also, it was much lower than that found in other study that demonstrated high awareness when dentists were asked about SDF, 62.7% answered that they heard about SDF topical application [33]. Moreover, our figure was significantly lower than the 77% found in the American Dental Education Association's (ADEA) annual survey of graduating U.S. dental students [26], and much lower the figure 92.45% of the dentists were aware of this material [34]. The reason of the low knowledge of SDF in our study may be due to the usage of SDF

in the dentistry is not yet generally approved and SDF material has lately been permitted in Libya; so, its usage among the Libyan dental community in Benghazi was unfamiliar.

When participants were asked about their opinions and understanding regarding SDF, "how much do you disagree/agree if SDF can be used to arrest cavitated lesions?". About 69.5% of the participants stated that they agreed/strongly agreed that SDF can be used to arrest cavitated lesions. Almost similar finding in a study reported that 67% respondents agreed using SDF to arrest carious lesions in primary teeth [26]. The figure in our results was higher than the ones found in other studies; it was higher than 61% [34], higher than the figure 55.3% [33] and much higher than that found in Saudi study, 50.4% of the participants agreed/strongly agreed that SDF can be used to arrest cavitated lesions [35]. But then again, our result was lower than that the figure 94.5% agreed that SDF arrests caries [36].

When participants were asked about their opinions and understanding regarding SDF, "how much do you disagree/agree if SDF can be used to arrest non-cavitated lesions?". Approximately 70% of the participants stated that they agreed/strongly agreed that SDF could be used to arrest non-cavitated lesions. Our figure was higher than that found in Saudi Arabian study, 56.3% of the participants agreed/strongly agreed that SDF can be used to arrest non-cavitated lesions [35].

When participants were asked about their opinions and understanding regarding SDF, "how much do you disagree/agree if SDF can be placed prior to all restoration?". Of the sample, more than half of participants (65.9%) stated that they agree/strongly agree that SDF could be placed prior to all restoration. Our result was in disagreement with another study conducted in Saudi Arabia, only 20.8% of the participants stated that they agreed/strongly agreed that SDF could be used prior to all restoration [35]. Also, it in disagreement with another study reported that only one-third of the respondents agreed that SDF should be used before all restorations [34]. Anyhow, the evidence behind the placement of SDF prior to restoration to prevent secondary caries is still limited and further studies are needed [11, 26].

When participants were asked, "how much do you agree/strongly agree if SDF can be placed prior to all restoration at caries risk patients?". Our study, about 76.8% of the participants stated that they agreed/strongly agreed that SDF could be used prior to all restoration at caries risk patients. Our figure was much higher than the one (44.6%) found in Saudi Arabian study [35].

In accordance with the American Academy of Pediatric Dentistry guidelines [23], our study demonstrated positive attitude towards SDF, which contributed to majority of the participants stated that they agreed/strongly agreed that using SDF to arrest cavitated, non-cavitated lesions, placing SDF prior to all restoration, prior to all restoration at caries risk patients and possible increase in using it in the future.

Generally, majority of pediatric dentistry program directors were concerned about parental acceptance to the implementation of SDF [37]. Currently, a wide range of parents would still accept SDF application, despite their intolerance of the black discoloration, to avoid extensive dental behavioral management such as general anesthesia or sedation [11, 38]. The significant advantages of SDF are its low cost, easy availability, easy to use, and it does not need any special tools for application. As well, with appropriate training, SDF is considered as a perfect material to arrest caries at least to people where there is limited or no access to dental management. Therefore, use of SDF should be encouraged and recognized as ideal treatment for young and challenging cases in Libya.

This current study had certain limitations. Firstly, SDF is only recently used in Libya, so a lack of experience and clinical using of SDF might affect participants' assessments and concerning with it. Secondly, the study sample was from public sector only and only from Benghazi city, which may not reflect those of private sectors and another area. Therefore, more studies with more focus on larger samples including dentists from other sectors and different areas are needed to provide more clear and generalized findings is needed. Though, the strength of the current study was raising many questions on areas that should be evaluated in future studies. However, this study enlightens the development, historical background information, action, clinical considerations of SDF. Also, it raises awareness on SDF material to have more application into dentists' clinical practice in Benghazi which in return will improve the knowledge and attitude towards SDF among Libyan practitioners. Furthermore, this study, up to my knowledge, has been one of the first attempts to thoroughly evaluate the Libyan dental practitioners' knowledge and attitude toward SDF in Benghazi.

Conclusion

The aim of the current study was accomplished as the knowledge and attitude about SDF among Libyan dental practitioners in Benghazi was evaluated. Usually in all surveys, only few numbers of questions could be asked. Hence, the data to be achieved is limited. Based on our findings, more study should contain other questions to clear up other factors which we could not discover in this study. Further research is required to accept it for that particular usage. As well, more research is necessary to evaluate SDF's acceptance, implementation, and adoption hurdles due to the lack of available data on its use. Anyway, this study can help program organizers assess their planes toward including uses of SDF and providing an adequate training in dental schools and dental facilities, including general dentists and dental students.

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Ethical approval

Ethical approval was obtained from the research ethical committee of University of Benghazi. Informed consent to provide information was obtained from all participants.

Conflicts of interest

The authors declare no conflict of interest.

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