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Knowledge, attitude, and barriers to the use of silver diamine fluoride among dental students: A hospital-based, cross-sectional study

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Abstract
Introduction: Prevention and control of dental caries is a challenging task in children. Silver diamine fluoride (SDF) has shown promise in arresting caries and preserving healthy tooth structure. However, data on dental students' knowledge and use of SDF are limited, and improving their understanding could enhance management of deep lesions in uncooperative children and those with special health care needs. The aim of this study was to assess the knowledge, attitude, and barriers to the use of silver diamine fluoride among undergraduate dental students.
Material and methods: The study was conducted among dental students (IV BDS and Interns) in Goa Dental College and Hospital. A customized, self-administered, printed questionnaire assessing the knowledge, attitude, and barriers to the use of silver diamine fluoride was designed, validated by ten subject experts and pilot tested prior to the commencement of the study. The questionnaire was provided to each student willing to participate in the study. Data obtained was tabulated and statistically analysed.
Results: A total of 149 students were included in the study. 61.4% had heard about SDF from dental schools. Most students had basic knowledge about SDF. 65.7% of the students were not using SDF, the most common reason being a lack of adequate knowledge/ expertise with the material. 74.2% students would you consider using SDF in the future.
Conclusion: Although most students were aware of SDF, their knowledge was limited; however, they showed a strong willingness to use it. Continuing education and hands-on training could enhance their competence and confidence in its clinical application.

Keywords: Silver diamine fluoride, pediatric dentistry, children, dental caries, knowledge, attitude

Introduction

Dental caries continues to be the most widespread and multifactorial chronic condition among children in India, with prevalence rates reported between 50.8% and 62.4%. This high burden persists despite the availability of preventive strategies, advancements in restorative care, and considerable emphasis on its management in routine dental practice [1]. The prevention and management of dental caries in children remains a considerable challenge, influenced by a wide range of factors including psychological aspects, demographic setting, urban–rural disparities, socio-economic status, cultural practices, age-related differences, oral hygiene attitudes, accessibility of dental services, and the demand for quick, cost-effective, non-invasive, and painless treatment options [2].

Ongoing research is exploring a diverse spectrum of biomaterials and therapeutic agents with the aim of identifying those capable of intervening at different stages of the caries process. The primary objectives include preventing lesion progression prior to cavitation and preserving the integrity of unaffected tooth structure by inhibiting subsequent demineralization and structural breakdown [3]. Silver diamine fluoride (SDF) represents one such material that fulfils these criteria while also offering additional psychological and emotional benefits, particularly for patients with dental anxiety [4].

Scientific evidence demonstrates that SDF is highly effective in arresting dental caries while offering a cost-efficient treatment option for individuals from lower socio-economic backgrounds and for those unable to undergo conventional dental procedures. Its application in primary dentition has also been proven both safe and effective, presenting a significant advantage in managing caries among high-risk pediatric populations, particularly children with intellectual or developmental disabilities [5].

A sound understanding of SDF among undergraduate students, along with its correct application, can greatly aid in the management of deep carious lesions, particularly in uncooperative pediatric patients and those with special health care needs. There is a lack of published literature evaluating students' knowledge, attitudes, and the barriers associated with SDF use, and no such study has yet been reported from the state of Goa. Therefore, the present investigation was undertaken to assess the knowledge, attitude, and barriers related to the use of SDF among dental students at Goa Dental College and Hospital.

Material and Methods

The study included a census sample of all IV BDS students and interns present on the day of the study and willing to participate in the study. Ethical approval was obtained from the institutional ethics committee. The questionnaire underwent face and content validation by 10 independent subject experts. For face validity assessment, each expert thoroughly reviewed the questionnaire and indicated 'Yes' or 'No' for each item, depending on whether it aligned with the intended construct. Validators were also encouraged to provide suggestions to refine the wording or structure of the items. The percentage agreement for each question was then determined using the following formula [6].

$$\frac{Number\ of\ agreed\ raters\ per\ question}{Total\ number\ of\ raters\ per\ question}\ x100$$

As all items demonstrated a percentage agreement ranging from 90% to 100%, no revisions were required following face validation. Subsequently, each expert completed a content validation form, rating every item as 'Essential', 'Useful but not essential', or 'Not necessary'. The Content Validity Ratio (CVR) for each item was then computed using the following formula [7]:

$$\mathbf{CVR} = (\boldsymbol{ne} - \boldsymbol{N/2})/(\boldsymbol{N/2})$$

Where; ne: number of panellists indicating 'essential' (E), N: total number of panellists

With 10 experts participating in content validation, an item was deemed valid only if its CVR exceeded 0.62 [7]. Revisions based on expert feedback were considered for items scoring below this threshold. As all items achieved a CVR greater than 0.62, no modifications were required. The questionnaire subsequently underwent pilot testing. The questionnaire comprised of two parts assessing the demographic details, and knowledge and attitudes of the students. Data from the students were collected on a single day in order to avoid bias in results.

On completion of the study, the collected data were organized into tables and analysed statistically. Categorical variables were reported as frequencies and percentages, and the relationships between variables were evaluated using the chi-square test, with a significance threshold of $P < 0.05$.

Results

Table 1 describes the demographic details of the participants. A total of 149 students (72 IV BDS; 77 interns) participated in the study.

Table 2 describes the knowledge, attitude, and barriers to the use of SDF among the participants. A total of 93.9% participants had heard about SDF (majority from dental schools). Although most students were aware of SDF, their knowledge was limited; however, they showed a strong willingness to use the material in the future.

Table 1: Demographic details of the participants

Gender	Year of Study Frequency (%)		Total Frequency (%)	Pearson Chi-Square test
	IV BDS	Interns		
Male	12 (16.6%)	14 (18.1%)	22 (14.7)	p=0.978>0.05
Female	60 (83.4%)	63 (81.9%)	110 (85.3%)	
	72	77	149	

Table 2: Knowledge, attitude, and barriers to the use of SDF among the participants

Question	Option	Year Of Study Frequency (%)		Total Frequency (%)	Pearson Chi-Square test
		IV BDS	Interns		
A. General Awareness					
1. Have you ever heard about SDFs application in Dentistry?	Yes	67 (93.0%)	73 (94.8%)	140 (93.9%)	p=0.917>0.05
	No	5 (7.0%)	4 (5.2%)	9 (6.1%)	
2. If yes, how did you hear about SDF? *(Multiple options can be selected)*	Continuing denta education	9 (13.4%)	5 (6.8%)	14 (10.0%)	p=0.23>0.05
	Dental school	33 (49.2%)	53 (72.6%)	86 (61.4%)	p=0.005<0.05
	Dental books	12 (17.9%)	9 (12.3%)	21 (15%)	p=0.50>0.05
	Online resources	8 (11.9%)	4 (5.4%)	12 (8.5%)	p=0.15>0.05
	Webinars/ seminars	0 (0%)	2 (2.7%)	2 (1.4%)	p=0.31>0.05
	Others	5 (7.4%)	0 (0%)	5 (3.6%)	p=0.072<0.05
B. Knowledge of the Participants on SDF					
3. What is SDF?	An agent used to manage dentinal hypersensitivity	10 (14.9%)	8 (10.9%)	18 (12.8%)	p=0.209>0.05
	An antimicrobial agent used to treat active dental caries and prevent further progression of disease	42 (62.6%)	57 (78.0%)	99 (70.7%)	
	Both above	10 (14.9%)	6 (8.2%)	16 (11.4%)	
	An antimicrobial liquid used to help promote oral hygiene	5 (7.4%)	2 (2.7%)	7 (5.0%)	
4. What concentration of SDF is commonly used for dental procedures?	20%	5 (7.4%)	15 (20.5%)	20 (14.2%)	p=0.00012<0.001
	38%	9 (13.4%)	44 (60.2%)	53 (37.8%)	
	25%	4 (5.9%)	4 (5.4%)	8 (5.7%)	
	Do not know	49 (73.1%)	10 (13.6%)	59 (42.1%)	
5. What is the amount of fluoride in SDF?	9040ppm	8 (11.9%)	4 (5.4%)	12 (8.5%)	p=0.003<0.05
	12,300ppm	6 (8.9%)	5 (6.8%)	11 (7.8%)	
	44,800ppm	0 (0%)	13 (17.8%)	13 (9.2%)	
	Do not know	53 (79.1%)	51 (69.8%)	104 (74.2%)	
6. Which component of SDF provides antimicrobial	Silver	49 (73.1%)	63 (86.3%)	112 (80.0%)	
	Ammonia	0 (0%)	5 (6.8%)	6 (4.2%)	

activity?	Fluoride	10 (14.9%)	4 (5.4%)	14 (10.0%)	p=0.002<0.05
	Do not know	8 (11.9%)	1 (1.3%)	9 (6.4%)	
7. The remineralizing agent in SDF is?	Silver	1 (1.4%)	2 (2.7%)	3 (2.1%)	p=0.55>0.05
	Ammonia	0 (0%)	0 (0%)	0 (0%)	
	Fluoride	66 (98.5%)	70 (95.8%)	136 (97.1%)	
	Do not know	0 (0%)	1 (1.3%)	1 (0.7%)	
C. ATTITUDE AND BARRIERS TO THE USE OF SDF					
8. SDF should be used in which of the following cases? *(Multiple options can be selected)*	Any kind of patients	4 (5.9%)	5 (6.8%)	9 (6.4%)	p=0.86>0.05
	Patients with special needs	25 (37.3%)	23 (31.5%)	22 (15.7%)	p=0.52>0.05
	High caries risk patients	20 (29.8%)	30 (41.0%)	45 (61.6%)	p=0.23>0.05
	Very young age patients	7 (10.4%)	15 (20.5%)	13 (9.2%)	p=0.041<0.05
	Uncooperative patients	15 (22.3%)	1 (1.3%)	10 (7.1%)	p=0.0002<0.05
9. For which teeth would SDF application be an acceptable treatment option? *(Multiple options can be selected)*	Primary anterior teeth	12 (17.9%)	5 (6.8%)	17 (12.1%)	p=0.08>0.05
	Primary posterior teeth	32 (47.7%)	20 (27.3%)	52 (37.1%)	p=0.015<0.05
	Permanent anterior teeth	9 (13.4%)	10 (13.6%)	19 (13.5%)	p=0.80>0.05
	Permanent posterior teeth	29 (43.2%)	35 (47.9%)	64 (45.7%)	p=0.41>0.05
10. Do you currently use SDF?	Yes	1 (1.4%)	47 (64.3%)	48 (34.2%)	p=0.02<0.05
	No	66 (47.1%)	26 (35.6%)	92 (65.7%)	
10. a. If not, why? *(Multiple options can be selected)*	Stains teeth black	11 (16.6%)	6 (23.0%)	17 (18.4%)	p=0.17>0.05
	Lack of parent/ caregiver acceptance	2 (3.0%)	0 (0%)	2 (2.1%)	p=0.30>0.05
	Cost of material	2 (3.0%)	6 (23.0%)	8 (8.6%)	p=0.028<0.05
	Metallic taste	4 (6.0%)	1 (3.8%)	5 (5.4%)	p=0.38>0.05
	Irritation to gingiva and oral mucosa	0 (0%)	0 (0%)	0 (0%)	-
	Lack of adequate knowledge/ expertise with the material	47 (71.2%)	13 (50.0%)	60 (65.2%)	p=0.037<0.05
11. Would you be interested in knowing more about SDF?	Yes	66 (98.5%)	73 (100%)	139 (99.2%)	p=0.32>0.05
	No	1 (1.4%)	0 (0%)	1 (0.7%)	
12. Would you consider using SDF in the future?	Yes	49 (73.1%)	55 (75.3%)	104 (74.2%)	p=0.18>0.05
	No	8 (11.9%)	3 (4.1%)	11 (7.8%)	
	Maybe	10 (14.9%)	15 (20.5%)	25 (17.8)	

Discussion

Managing dental caries in uncooperative children and those with special health care needs is challenging. Silver diamine fluoride, a cost-effective and non-invasive agent, arrests caries and reduces dentin hypersensitivity [8,9]. A thorough understanding of SDF and its proper application by undergraduate students aids in the effective management of deep carious lesions in these patients.

It was found that 93.9% subjects were aware of the use of SDF in dentistry, which was greater than that found by Al Ashwal *et al*. [10]. Majority of the students acquired knowledge about SDF from the dental school itself. This value was similar to that found by Ezzeldin *et al*. [11]. However, a study by Arichandran *et al*. revealed that a majority of the undergraduate students gained knowledge about SDF through online resources [8]. The American Academy of Pediatric Dentistry (AAPD) supports the education of dental students, residents, oral health professionals and their staffs regarding the use of SDF [12].

Silver diamine fluoride is an antimicrobial agent capable of arresting active carious lesions [9]. The synergistic interaction between silver and fluoride in an alkaline solution demonstrates enhanced efficacy in arresting active carious lesions. Furthermore, SDF has been utilized in the management of dentin hypersensitivity as it forms a precipitate that partially occludes exposed dentinal tubules [13]. In this study, 11.4% students knew that SDF can be used to arrest caries and manage dentin hypersensitivity. While 70.7% students felt that SDF can be used only to treat active carious lesions. However, Arichandran *et al*. reported that 57.3% of the undergraduates in their study agreed that SDF can be used to arrest cavitated carious lesions [8].

Silver diamine fluoride is commercially available in concentrations of 10%, 12%, 30%, and 38%. However, the commonly used concentration is 38% [9]. It was found that 37.8% students were aware that 38% is most effective and commonly used concentration of SDF. A solution of 38% SDF contains 44,800 ppm of fluoride [9]. Only 9.2% students were aware of the concentration of fluoride in SDF, which was lower than that reported by Arichandran *et al*. [8].

Silver ions present in SDF exhibit a trimodal mechanism of antibacterial action. Initially, they disrupt bacterial cell wall integrity, resulting in cell lysis. Subsequently, silver ions interfere with bacterial DNA replication and inhibit key metabolic enzymes essential for cellular respiration. Finally, ionic interactions between silver and bacterial surface

proteins are thought to inhibit microbial aggregation, a critical step in the initiation and progression of dental caries [14]. In this study, most of the students were aware that silver ions in SDF provide antimicrobial activity. Similar results were obtained in a study by Al Ashwal *et al*. [10].

The fluoride in SDF has superior penetration into both enamel and dentin when compared to alternative fluoride formulations. This deeper penetration leads to the formation of a fluoride reservoir within the tooth, which supports remineralization processes and the development of fluorapatite, enhancing the tooth's resistance to caries and improving its structural hardness [14]. A systematic review by Trieu *et al*. 2019, stated that SDF is more effective against caries than sodium fluoride [15]. In this study, majority of the students were aware that the remineralizing capacity of fluoride was due to the presence of fluoride ions.

The AAPD recommends the application of SDF for active cavitated carious lesions in children at high risk of caries, particularly in those with behavioural or medical challenges, multiple cavitated lesions that cannot be treated in a single visit, or children facing difficulties in accessing dental care, provided there are no clinical signs of pulpal involvement [16]. Most of the students believed that SDF should be used in high caries risk patients and children with special health care needs. Similar results were obtained in a study by Al Ashwal *et al*. [10].

The AAPD suggests the use of SDF in both anterior as well as posterior teeth in high caries risk individuals to arrest the progression of dental caries [16]. However, a study by Almarwan *et al*. stated that parental acceptance of SDF was higher for primary compared to permanent teeth and posterior compared to anterior teeth in both dentitions due to the staining potential of the agent [17]. In this study, 45.7% of students felt that SDF would be an acceptable treatment option for permanent posterior teeth followed by primary posterior teeth (37.1%). Al Ashwal *et al*. reported that majority students considered SDF to be an acceptable treatment option for primary posterior followed by anterior teeth [10].

Majority of the participants had not used SDF owing to limited knowledge (65.2%) and the fear of its staining potential (18.4%). Most of the students were interested in knowing more about SDF and 74.2% of the students considered using SDF in the future, which was similar to a finding obtained previously [8].

Future investigations should be directed towards examining the extent of awareness, perception, and clinical application of SDF among dental students as well as practicing dentists in India and in international contexts. Such studies would provide valuable insights into existing gaps in knowledge and utilization patterns. Furthermore, it is essential to design and implement targeted educational interventions, workshops, and evidence-based training programs to strengthen the understanding of SDF among dental practitioners, thereby facilitating its appropriate and widespread use in clinical practice.

Conclusion

It can be concluded that while the majority of students were aware of the application of SDF in dentistry, their overall knowledge remained inadequate. Nevertheless, most students expressed a strong willingness to incorporate SDF into their future practice. Structured continuing dental education initiatives, including workshops and hands-on training programs, are likely to strengthen students' knowledge base and enhance their confidence in the effective use of SDF.

References

1. Jabin Z, Vishnupriya V, Agarwal N, Nasim I, Jain M, Sharma A. Effect of 38% silver diamine fluoride on control of dental caries in primary dentition: A Systematic review. Journal of Family Medicine and Primary Care,2020:9(3):1302–1307.
2. Akshitha E, Girish SR, Shankar S, Lalithambigai G, John S. Assessment of parental perceptions and acceptance of silver diamine fluoride staining among the children with dental caries experience in a Town in South India – A cross-sectional study. Journal of Global Oral Health,2022:5(1):20–24.
3. Chai HH, Kiuchi S, Osaka K, Aida J, Chu CH, Gao SS. Knowledge, Practices and Attitudes towards Silver Diamine Fluoride Therapy among Dentists in Japan: A Mixed Methods Study. International Journal of Environmental Research and Public Health,2022:19(14):8705.
4. Contreras V, Toro MJ, Elías-Boneta AR, Encarnación-Burgos A. Effectiveness of silver diamine fluoride in caries prevention and arrest: a systematic literature review. General Dentistry,2017:65(3):22–29.
5. Alajlan G, Alshaikh H, Alshamrani L, Alanezi M, Alarfaj S, AlSwayyed T. Knowledge on and Attitude toward Silver Diamine Fluoride among Saudi Dental Practitioners in Riyadh Public Hospitals. Clinical, Cosmetic and Investigational Dentistry,2020:12:399–407.
6. Patel N, Desai S. ABC of face validity for questionnaire. International Journal of Pharmaceutical Sciences Review and Research,2020:65:164–168.
7. Lawshe CH. A quantitative approach to content validity. Personnel Psychology,1975:28:563–575.
8. Arichandran A, Moses J, Ranj E. Knowledge on silver diamine fluoride in pediatric dentistry among dental students in Tamil Nadu-A questionnaire-based survey. International Journal of Pedodontic Rehabilitation,2022:7(2):39–45.
9. Yan IG, Zheng FM, GAO SS, Duangthip D, Lo ECM, Chu CH. Ion Concentration of Silver Diamine Fluoride Solutions. International Dental Journal,2022:72(6):779–784.
10. Al Ashwal LA, Al Kharan MI. Assessment of knowledge about silver diamine fluoride in Riyadh Elm University among students (levels 11 and 12) and interns. International Journal of Medicine in Developing Countries,2020:4:1831–1836.
11. Ezzeldin T, Al-Awasi KA, Bader RM, Alshaikhi AY, Hakami AH, Siddiqui IA, *et al*. A Study to assess the awareness and use of Silver Diammine Fluoride and Hall Technique among dental professionals and dental students in the Eastern Province. Saudi Dental Journal,2021:33(8):1166–1173.
12. American Academy of Pediatric Dentistry. Policy on the use of silver diamine fluoride for pediatric dental patients. The Reference Manual of Pediatric Dentistry. Chicago, Ill.: American Academy of Pediatric Dentistry, 2022, 72-75.
13. Jiang CM, Duangthip D, Chan AK, Tamrakar M, Lo EC, Chu CH. Global research interest regarding silver

diamine fluoride in dentistry: a bibliometric analysis. Journal of Dentistry,2021:113:103778.
14. Burgess JO, Vaghela PM. Silver Diamine Fluoride: A Successful Anticarious Solution with Limits. Advances in Dental Research,2018:29(1):131–134.
15. Trieu A, Mohamed A, Lynch E. Silver diamine fluoride versus sodium fluoride for arresting dentine caries in children: a systematic review and meta-analysis. Scientific Reports,2019:9(1):2115.
16. Crystal YO, Marghalani AA, Ureles SD, *et al*. Use of silver diamine fluoride for dental caries management in children and adolescents, including those with special health care needs. Pediatric Dentistry,2017:39(5):135–145.
17. Almarwan M, Almawash A, AlBrekan A, Albluwi S. Parental Acceptance for the Use of Silver Diamine Fluoride on Their Special Health Care-Needs Child's Primary and Permanent Teeth. Clinical, Cosmetic and Investigational Dentistry,2021:13:195–200.