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Pediatric Dentists' Knowledge, Attitudes, and Practices of Silver Diamine Fluoride Applications in Türkiye: A Cross-Sectional Study

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ABSTRACT

Purpose: Silver Diamine Fluoride (SDF) is a non-invasive, topically applied agent used in the treatment of dental caries. Since it is a current material, its prevalence among pediatric dentists is being discussed. The study aims to evaluate the level of knowledge, attitudes, and practices about SDF among pediatric dentists.

Methods: A survey was created using Google Forms and sent via email to 950 pediatric dentists who are members of the Turkish Society of Pediatric Dentistry. 201 people responded (21.1%).

Results: Nearly all of the participants (98.5%) had heard of SDF. However, a significant gap between awareness and practical application is evident, as only about one-third of participants have actually applied for SDF. 85% of the participants agreed that SDF can be used in children with cooperation problems. 94.5% of the participants agreed that SDF is effective in preventing caries with a significant difference based on experience period ($p = 0.032$). The majority of participants (85.5%) reported that they need more training about the SDF.

Conclusions: The large gap between those who know SDF and those who apply it shows that more practical training and applied experience with SDF are needed in clinical settings.

Keywords: *Dental caries; silver diamine fluoride; knowledge; practices; pediatric dentist; pediatric dentistry; survey*

INTRODUCTION

Silver diamine fluoride **(SDF)** has been utilized in clinical practice in Japan since the 1970s.[1] SDF is a topically applied liquid employed for treating tooth hypersensitivity and stopping cavitated carious lesions in both adults and children.[2,3] SDF helps reduce the frequency of emergency department visits for children with early childhood caries on treatment waiting lists.[4] Moreover, it is an uncomplicated, secure, economical, and efficient treatment approach, proven to be beneficial for individuals at a high risk of cavities and for those who cannot endure traditional invasive treatments. However, despite these benefits, the most apparent drawback of SDF is its side effect of causing a permanent black stain on carious lesions.[5] The inhibition technique relied on the disinfecting properties of silver and the remineralizing effect of fluoride. SDF has been documented to exhibit notable antibacterial activity and inhibit demineralization and collagen degradation, and its safety has been substantiated.[6]

SDF solutions can be applied to exposed dentin to interact with hydroxyapatite, resulting in the generation of calcium fluoride, silver phosphate, and silver precipitates. This process effectively blocks dentinal tubules, serving as desensitizers.[7] SDF is used in dentistry in various concentrations, including 12%, 30%, and 38%, with the latter being the most commonly utilized commercially. The 38% SDF has demonstrated significant effectiveness in both halting the progression of active cavities and preventing new ones.[8]

SDF plays a crucial role in managing cavities, particularly in children with a high risk of cavities, those with medical compromises, individuals facing behavioral challenges, and those with difficulty accessing dental care.[8] The application of SDF is fast,

straightforward, and does not necessitate specialized equipment, making it ideal for implementation in community-based or medical clinic settings.[9]

In 2022, a nationwide study conducted by the American Academy of Pediatrics revealed encouraging trends. The study indicated a positive shift over the past decade, with a growing involvement of pediatricians in oral health. Fewer pediatricians reported facing obstacles when integrating oral health into their practice. Particularly noteworthy was the substantial increase in the number of pediatricians who considered applying fluoride varnish as part of their responsibilities to prevent dental caries and actively provided this service in their practices.[10]

Although no current research has yet examined how effectively dental schools educate their graduates about SDF, Nelson et al.[11] reported in 2016 that 79.9% of pediatric dentistry residency programs in the United States had begun incorporating SDF-related content into their curricula, with a quarter of these programs applying it in clinical practice. Assessing pediatric dentists' educational experiences, knowledge, attitudes, and clinical application of SDF would provide a valuable opportunity to explore whether enhanced education in this area leads not only to greater knowledge acquisition but also to more favorable attitudes and increased utilization in professional practice.[12] Through this survey, we seek to elucidate the current landscape of SDF usage among pediatric dentists, identifying potential barriers, misconceptions, and areas for improvement. By gaining insights into the perspectives and experiences of practitioners, we aim to facilitate evidence-based recommendations for enhancing the adoption and efficacy of SDF in pediatric dental practice, ultimately contributing to improved oral health outcomes for children. Thus, this survey aims to explore the knowledge, attitudes, and practices of pediatric dentists regarding the application of SDF in clinical settings.

MATERIAL AND METHODS

Participants

The study was approved by Marmara University Faculty of Dentistry Clinical Research Ethics Committee (protocol number: 2023-134). The study complies with the Declaration of Helsinki. The sample of this cross-sectional study consisted of pediatric dentists in Türkiye who are currently enrolled in or have completed doctorate/specialization/master's degree programs. The questionnaire was sent to participants by e-mail. 950 pediatric dentists were invited to the study. Out of these participants, 201 completed the questionnaire, with a response rate of 21.1%. Participation in the research was anonymous and based on voluntary participation. At the beginning of the questionnaire, participants were provided with detailed information and contact details of the corresponding researcher.

Based on the study of Robaian et al.[13] the minimum sample size was determined with G*Power 3.1.9.6 software (Faul, Erdfelder, Lang, and Buchner, Düsseldorf, Germany) to be 75 in total, with 25 participants in each group, assuming a 95% confidence level (1-α), 95% test power (1-β), and an effect size of 0.473. Due to the expectation that participation in the survey would be very low, with an anticipated response rate of less than 10%, recruitment emails were sent to all 950 members of the Turkish Society of Pediatric Dentistry.

Questionnaire

The study was conducted between March 2023 and November 2023. An online questionnaire was designed in Google Forms, and the questionnaire link was distributed to members through the agency of the Turkish Pedodontics Association.

The questions were developed by reviewing relevant studies in the literature.[12-14] The questionnaire included five main sections consisting of demographic information and 18 closed-ended questions. The first section included demographic information about participants' characteristics such as gender, age, education level, duration of experience, and institution (public, university, etc.). Sections 2–5 were about participants' education about SDF, clinical application of SDF, advantages and disadvantages of SDF, and participants' preferences regarding the use of SDF, respectively. The 4th and 5th sections contained questions prepared on a 5-point Likert scale ranging from "strongly disagree" to "strongly agree". Additionally, when a participant stated that they did not use SDF at the beginning of the 3rd section, the questionnaire automatically passed to the 4th section. Answers to all questions were mandatory, so there would be no missing questions if the survey was completed.

Statistical Analysis

Descriptive statistics were presented as frequencies and percentages. Relationships between categorical variables were evaluated using the Pearson Chi-square test. The answers were compared according to their duration of experience (1-4 years, 5-9 years, or 10+ years) and institutions (public hospital, private clinic, university, or both university and private clinic). The institutions where dentists work do not influence their level of knowledge but affect their treatment practices based on available resources, materials, and institutional policies. Therefore, the Pediatric Dentists' responses were compared by institution only in terms of treatment practices. The Data was analyzed using SPSS 26.0 software (IBM Corp., Armonk, NY, USA), and $p<0.05$ was considered statistically significant.

RESULTS

Among these participants, 113 (56.2%) were postgraduate students (PhD/specialty/MSc), 52 (25.8%) were faculty members, and 36 (17.9%) were specialists or held a PhD/MSc degree in pediatric dentistry. The demographic information of the participants was presented in **Table 1**. Approximately half of the participants were in the 20-29 age range, half were female, half had 1-4 years of experience, and half worked at a university hospital. Approximately half of the participants were aged between 20 and 29 years, had 1 to 4 years of experience, and were employed at a university hospital. The majority of the participants were female.

Table 2 provides an overview of participants' awareness and experience of SDF, training needs, and clinical applications such as application patterns, frequency, concentration, coloring, and additional procedures. Participants with less experience more frequently reported a need for further training on SDF. Additionally, the training needs regarding SDF differed significantly across r participants with varying levels of experience ($p = 0.016$). All participants reported applying SDF either during or after their postgraduate education. Less experienced participants tended to apply SDF more frequently during their postgraduate education, while more experienced participants applied it predominantly after completing their postgraduate education. Additionally, there was a statistically significant difference in responses according to the level of experience ($p < 0.001$). The majority of participants do not use any agents for coloration after SDF application. All participants who reported using an agent to minimize discoloration after SDF application were using potassium iodide. The difference in approaches is statistically significant ($p = 0.003$). Additionally, when participants were asked about the cases in which they used SDF, 98% reported using it to arrest dental caries, 54% for relieving tooth sensitivity, 45% for preventing dental caries, 23% for pulp protection, and 7% as a disinfectant in root canal treatments. **Table 3** presents the practices preferred by participants who reported performing SDF treatment.

Tables 4, 5, and **6** show the responses of participating pediatric dentists regarding the advantages and disadvantages of SDF in clinical practice. Table 4 presents items regarding the clinical use of SDF, Table 5 presents suitable patient profiles for SDF, and Table 6 presents items on the advantages and disadvantages of SDF indications. The only item among the advantage and disadvantage questions that showed a difference based on pediatric dentists' levels of experience was the effectiveness of SDF in preventing caries ($p = 0.032$). A high proportion of participants agreed on this point.

Table 1. Characteristics of pediatric dentists participating in survey about Silver Diamine Fluoride (N=201)

Characteristic	N (%)
Age	
20-29	103 (51.2%)
30-39	79 (39.3%)
40-49	17 (8.5%)
50+	2 (1%)
Total	201 (100%)
Gender	
Male	26 (12.9%)
Female	175 (87.1%)
Years of Experience	
1-4 years	100 (49.8%)
5-9 years	65 (32.3%)
More than 10 years	36 (17.9%)
Institutions	
Private	42 (20.9%)
Government	16 (8%)
University	116 (57.7%)
Both	27 (13.4%)
Total	201 (100%)

N: Number

Table 2. The responses of pediatric dentists regarding the clinical application of Silver Diamine Fluoride according to their duration of experience and their institutions

		Experience Period N (%)					Institutions N (%)					
		1-4 Years	5-9 Years	More than 10 Years	Total	P‡	Public hospital	Private clinic	University	Both private c.& university	Total	P‡
Have you heard of SDF before?	Yes	98 (49.5)	64 (32.3)	36 (18.2)	198	0.697	16 (8.1)	40 (20.2)	115 (58.1)	27 (13.6)	198	0.259
	No	2 (66.7)	1 (33.3)	0	3		0	2 (66.7)	1 (33.3)	0	3	
Have you ever applied SDF before?	Yes	24 (42.9)	17 (30.4)	15 (26.8)	56	0.119	7 (12.5)	13 (23.2)	28 (50)	8 (14.3)	56	0.384
	No	76 (52.4)	48 (33.1)	21 (14.5)	145		9 (6.2)	29 (20)	88 (60.7)	19 (13.1)	145	
Have you used SDF for the treatment of tooth sensitivity?	Yes	7 (46.7)	2 (13.3)	6 (40)	15	0.186	2 (13.3)	5 (33.3)	7 (46.7)	1 (6.7)	15	0.616
	No	17 (41.5)	15 (36.6)	9 (22)	41		5 (12.2)	8 (19.5)	21 (51.2)	7 (17.1)	41	
Do you plan to use SDF in the future?	Yes	87 (50.6)	55 (32)	30 (17.4)	172	0.967	14 (8.1)	30 (17.4)	104 (65.5)	24 (14)	172	0.061
	No	2 (50)	1 (25)	1 (25)	4		0	3 (75)	1 (25)	0	4	
	Undecided	11 (44)	9 (36)	5 (20)	25		2 (8)	9 (36)	11 (44)	3 (12)	25	
I think I need more training about the SDF.	Yes	86 (52.8)	54 (33.1)	23 (14.1)	163	**0.016**	12 (7.4)	31 (19)	98 (60.1)	22 (13.5)	163	0.573
	No	6 (27.3)	9 (40)	7 (31.8)	22		3 (13.6)	6 (27.3)	9 (40.9)	4 (18.2)	22	
	Undecided	8 (50)	2 (12.5)	6 (37.5)	16		1 (6.3)	5 (31.3)	9 (56.3)	1 (6.3)	16	
Where have you applied or are you applying SDF?	During PGE	22 (61.1)	11 (30.6)	3 (8.3)	36	**<0.001**	5 (13.9)	7 (19.4)	18 (50)	6 (16.7)	36	0.553
	After PGE	3 (10.7)	11 (39.3)	14 (50)	28		2 (7.1)	9 (32.1)	14 (50)	3 (10.7)	2	
How many times have you used SDF in your clinic in the last 1 month?	0	16 (43.2)	15 (40)	6 (16.2)	37	0.164	7 (18.6)	9 (24.3)	18 (48.6)	3 (8.1)	37	0.063
	1-3	4 (41.7)	2 (16.7)	5 (41.7)	12		0	1 (8.3)	8 (66.7)	3 (25)	12	
	4-9	2 (40)	0	3 (60)	5		0	1 (20)	2 (40)	2 (40)	5	
	More than 10	1 (50)	0	1 (50)	2		0	2 (100)	0	0	2	
What is your SDF application period?	10 seconds	2 (22.2)	4 (44.4)	3 (33.3)	9	0.254	2 (22.2)	3 (33.3)	4 (44.4)	0	9	0.145
	1 minutes	10 (43.5)	4 (17.4)	9 (39.1)	23		1 (4.3)	5 (21.7)	14 (60.9)	3 (13)	23	
	1-4 minutes	7 (43.8)	7 (43.8)	2 (12.5)	16		4 (25)	5 (31.3)	4 (25)	3 (18.8)	16	
	Undecided	5 (62.5)	2 (25)	1 (12.5)	8		0	0	6 (75)	2 (25)	8	
What concentration of SDF do you prefer?	10	1 (100)	0	0	1	0.308	0	1 (100)	0	0	1	0.156
	12	1 (50)	1 (50)	0	2		1 (50)	0	1 (50)	0	2	
	30	1 (50)	0	1 (50)	2		1 (50)	0	1 (50)	0	2	
	38	17 (45.9)	8 (21.6)	12 (32.4)	37		2 (5.4)	7 (18.9)	23 (62.2)	5 (13.5)	37	
	I don't know	4 (28.6)	8 (57.1)	2 (14.3)	14		3 (21.4)	5 (35.7)	3 (21.4)	3 (21.4)	14	

Table 2. The responses of pediatric dentists regarding the clinical application of Silver Diamine Fluoride according to their duration of experience and their institutions *(continue)*

		Experience Period N (%)					Institutions N (%)					
		1-4 Years	5-9 Years	More than 10 Years	Total	P‡	Public hospital	Private clinic	University	Both private c.& university	Total	P‡
Do you use any agents for coloration after SDF application?	Yes	1 (50)	1 (50)	0	2	0.055	0	1 (50)	1 (50)	0	2	0.850
	No	21 (44.7)	16 (34)	10 (21.3)	47		6 (12.8)	10 (21.3)	23 (48.9)	8 (17)	47	
	I use SDF solutions containing anti-coloring agents	2 (28.6)	0	5 (71.4)	7		1 (14.3)	2 (28.6)	4 (57.1)	0	7	
For no or less discoloration	Then I apply Potassium Iodide	2 (25)	0	6 (75)	8	0.003	0	2 (25)	6 (75)	0	8	0.326
	I do not apply any extra treatment.	21 (44.7)	17 (36.2)	9 (19.1)	47		6 (12.8)	11 (23.4)	22 (46.8)	8 (17)	47	

SDF: Silver Diamine Fluoride, **PGE:** Postgraduate Education, ‡Pearson Chi-square, Bold font: P < 0.05

Table 3. Practices preferred by respondents during Silver Diamine Fluoride treatment

During the application of Silver Diamine Fluoride N (%)	
I isolate the teeth from saliva.	55 (98.2)
I ensure that SDF does not come into contact with the perioral area and cheeks.	54 (96.4)
I ensure that the SDF bottle is immediately sealed after use.	46 (82.1)
I protect the lips and the perioral area with petroleum jelly.	44 (78.6)
I clean the area with a polishing brush before SDF application.	35 (62.5)
I do not use a curing light after SDF application.	34 (60.7)
I use dental floss when applying SDF to interproximal areas.	29 (51.8)
I apply a different fluoride gel to the treated and adjacent teeth after SDF application.	22 (39.3)
I use air and water spray after the application.	14 (25)
I rinse the area with sterile saline or water after the application.	12 (21.4)
I apply SDF under rubber dam isolation.	5 (8.9)
I apply acid to the cavity before SDF application.	5 (8.9)
I apply hydrogen peroxide to prevent staining in areas treated with SDF.	0

SDF: Silver Diamine Fluoride

Table 4. Responses of pediatric dentists regarding the advantages and disadvantages of Silver Diamine Fluoride in clinical application according to their duration of experience

	Experience Period N (%)					Experience Period N (%)				
	1-4 Years	5-9 Years	More than 10 years	Total (N)	P‡	1-4 Years	5-9 Years	More than 10 years	Total (N)	P‡
	It is an easy treatment to apply.					**It has a taste that is undesirable to the child.**				
Strongly disagree	3 (50)	2 (33.3)	1 (16.7)	6		3 (50)	3 (50)	0	6	
Disagree	5 (41.7)	5 (41.7)	2 (16.7)	12		10 (66.7)	2 (13.3)	3 (20)	15	
Neutral	16 (53.3)	9 (30)	5 (16.7)	30	0.814	40 (43.5)	31 (33.7)	21 (22.8)	92	0.104
Agree	46 (54.8)	27 (32.1)	11 (13.1)	84		33 (47.1)	25 (35.7)	12 (17.1)	70	
Strongly agree	30 (43.5)	22 (31.9)	17 (24.6)	69		14 (77.8)	4 (22.2)	0	28	
	It is a noninvasive treatment.					**It can be toxic.**				
Strongly disagree	6 (54.4)	4 (36.4)	1 (9.1)	11		5 (29.4)	5 (29.4)	7 (41.2)	19	
Disagree	4 (100)	0	0	4		21 (40.4)	20 (38.5)	11 (21.2)	52	
Neutral	2 (40)	1 (20)	2 (40)	5	0.258	42 (52.5)	27 (33.8)	11 (13.8)	80	0.065
Agree	28 (53.8)	19 (36.5)	5 (9.6)	52		27 (62.8)	9 (20.9)	7 (16.3)	43	
Strongly agree	60 (46.5)	41 (31.8)	28 (21.7)	129		5 (55.6)	4 (44.4)	0	9	
	It can be applied in a short time.					**It is harmful due to its high fluoride content.**				
Strongly disagree	4 (57.1)	2 (28.6)	1 (14.3)	7		50 (52.6)	28 (29.5)	17 (17.9)	95	
Disagree	3 (50)	3 (50)	0	6		34 (44.2)	31 (40.3)	12 (15.6)	77	
Neutral	10 (40)	9 (36)	6 (24)	25	0.392	9 (45)	4 (20)	7 (35)	20	0.150
Agree	39 (54.9)	25 (35.2)	7 (9.9)	71		3 (60)	2 (40)	0	5	
Strongly agree	44 (47.8)	26 (28.3)	22 (23.9)	92		4 (100)	0	0	4	
	It is economical.					**It may cause discoloration of teeth.**				
Strongly disagree	9 (56.3)	5 (31.3)	2 (12.5)	16		2 (66.7)	1 (33.3)	0	3	
Disagree	16 (50)	14 (43.8)	2 (6.3)	32		2 (50)	0	2 (50)	4	
Neutral	31 (43.7)	25 (35.2)	15 (21.2)	71	0.499	1 (16.7)	2 (33.3)	3 (50)	6	0.059
Agree	26 (56.5)	11 (23.9)	9 (19.6)	46		23 (39.7)	26 (44.8)	9 (15.5)	58	
Strongly agree	18 (50)	10 (27.8)	8 (22.2)	36		72 (55.4)	36 (27.7)	22 (16.9)	130	
	It is not an aesthetic treatment.					**It is a painless treatment.**				
Strongly disagree	8 (53.3)	6 (40)	1 (6.7)	15		2 (50)	1 (25)	1 (25)	4	
Disagree	5 (83.8)	1 (16.7)	0	6		1 (100)	0	0	1	
Neutral	7 (38.9)	5 (27.8)	6 (33.3)	18	0.404	1 (16.7)	3 (50)	2 (33.3)	6	0.577
Agree	25 (43.9)	21 (36.8)	11 (29.3)	57		23 (46.9)	20 (40.8)	6 (12.2)	49	
Strongly agree	55 (52.4)	32 (30.5)	18 (17.1)	105		73 (51.8)	41 (29.1)	27 (19.1)	141	
	It is harmful due to its high silver content.									
Strongly disagree	34 (56.7)	15 (25)	11 (18.3)	60						
Disagree	37 (46.3)	29 (36.3)	14 (17.5)	80						
Neutral	21 (42.9)	17 (34.7)	11 (22.4)	49	0.610					
Agree	5 (62.5)	3 (37.5)	0	8						
Strongly agree	3 (75)	1 (25)	0	4						

‡Pearson Chi-square, Bold font: P < 0.05

Table 5. Responses of pediatric dentists regarding the advantages and disadvantages of suitable patient profiles for Silver Diamine Fluoride according to their duration of experience

	Experience Period N (%)					Experience Period N (%)				
	1-4 Years	5-9 Years	More than 10 years	Total (N)	P‡	1-4 Years	5-9 Years	More than 10 years	Total (N)	P‡
	SDF is effective in preventing caries.					**I prefer treatment with SDF over general anesthesia if possible.**				
Strongly disagree	2 (33.3)	3 (50)	1 (16.7)	6		10 (50)	7 (35)	3 (15)	20	
Disagree	1 (50)	1 (50)	0	2		20 (51.3)	12 (30.8)	7 (17.9)	29	
Neutral	0	0	3 (100)	3	0.032	20 (37)	23 (42.6)	11 (20.4)	54	0.448
Agree	32 (45.7)	24 (34.3)	14 (20)	70		30 (60)	14 (28)	6 (12)	50	
Strongly agree	65 (54.2)	37 (30.8)	18 (15)	120		20 (52.6)	9 (23.7)	9 (23.7)	38	
	SDF for caries treatment should be used not only by the specialist dentist but also by the general dentist.					**SDF may be a good treatment option for patients with severe dental anxiety.**				
Strongly disagree	17 (51.5)	13 (39.4)	3 (9.1)	33		2 (100)	0	0	2	
Disagree	27 (61.4)	11 (25)	6 (13.6)	44		2 (40)	2 (40)	1 (20)	5	
Neutral	23 (46)	13 (26)	14 (28)	50	0.214	8 (44.4)	5 (27.8)	5 (27.8)	18	0.640
Agree	20 (50)	15 (37.5)	5 (12.5)	40		43 (44.8)	36 (37.5)	17 (17.7)	96	
Strongly agree	13 (38.2)	13 (38.2)	8 (23.5)	34		2 (100)	0	0	2	
	I would consider treatment with SDF in patients who have cooperation problems with conventional restoration application.					**SDF may be a good treatment option for patients using bisphosphonates.**				
Strongly disagree	1 (50)	1 (50)	0	2		2 (50)	0	2 (50)	4	
Disagree	1 (25)	2 (50)	1 (25)	4		3 (37.5)	5 (62.5)	0	8	
Neutral	9 (37.5)	10 (41.7)	5 (20.8)	24	0.859	37 (50)	23 (31.1)	14 (18.9)	74	0.384
Agree	39 (50)	26 (33.3)	13 (16.7)	78		29 (47.5)	22 (36.1)	10 (16.4)	61	
Strongly agree	50 (53.8)	26 (28)	17 (18.3)	93		29 (53.7)	15 (27.8)	10 (18.5)	54	
	SDF may be a good treatment option for patients who are receiving chemotherapy and radiotherapy or have recently received radiotherapy.					**SDF may be a good treatment option if there are lesions that are difficult to reach in patients with mouth opening restrictions (microstomia)**				
Strongly disagree	2 (66.7)	0	1 (33.3)	3		0	0	1 (100)	1	
Disagree	1 (11.1)	6 (66.7)	2 (22.2)	9		4 (33.3)	6 (50)	2 (16.7)	12	
Neutral	21 (46.7)	18 (40)	6 (13.3)	55	0.245	21 (53.8)	13 (33.3)	5 (12.8)	39	0.390
Agree	41 (51.9)	22 (27.8)	16 (20.3)	79		38 (46.9)	28 (34.6)	15 (12.8)	81	
Strongly agree	35 (53.8)	19 (29.2)	11 (16.9)	65		37 (54.4)	18 (26.5)	13 (19.1)	68	
	SDF may be good treatment option for patients with special care needs (mental impairment, physical disability).									
Strongly disagree	3 (100)	0	0	3						
Disagree	1 (25)	2 (50)	1 (25)	4						
Neutral	6 (37.5)	6 (37.5)	4 (25)	16	0.638					
Agree	43 (51.8)	28 (33.7)	12 (14.5)	83						
Strongly agree	47 (49.5)	29 (30.5)	19 (20)	94						

SDF: Silver Diamine Fluoride, ‡Pearson Chi-square, Bold font: P < 0.05

Table 6. Responses of pediatric dentists regarding the advantages and disadvantages of Silver Diamine Fluoride indications according to their duration of experience

	Experience Period N (%)					Experience Period N (%)				
	1-4 Years	5-9 Years	More than 10 years	Total (N)	P‡	1-4 Years	5-9 Years	More than 10 years	Total (N)	P‡
	SDF is a good treatment option for carious lesions in posterior primary teeth.					**Infected soft dentin must be removed before SDF is applied.**				
Strongly disagree	3 (75)	1 (25)	0	4		6 (50)	4 (33.3)	2 (16.7)	12	
Disagree	3 (37.5)	3 (37.5)	2 (25)	8		28 (56)	16 (32)	6 (12)	50	
Neutral	21 (60)	11 (31.4)	3 (8.6)	35	0.725	21 (41.2)	17 (33.3)	13 (25.5)	51	0.827
Agree	44 (45.8)	33 (34.4)	19 (19.8)	96		36 (51.14)	23 (32.9)	11 (15.7)	70	
Strongly agree	29 (50)	17 (29.3)	12 (20.7)	58		9 (50)	5 (27.8)	4 (22.2)	18	
	SDF is a good treatment option for carious lesions in posterior permanent teeth.					**SDF can be used in cavitated root caries.**				
Strongly disagree	10 (76.9)	2 (15.4)	1 (7.7)	13		5 (55.6)	4 (44.4)	0	9	
Disagree	24 (45.3)	18 (34)	11 (20.8)	53		16 (72.7)	2 (9.1)	4 (18.2)	22	
Neutral	30 (49.2)	23 (37.7)	8 (13.1)	61	0.405	31 (54.4)	16 (28.1)	10 (17.5)	57	0.139
Agree	26 (48.1)	18 (33.3)	1018.5)	54		35 (41.7)	34 (40.5)	15 (17.9)	84	
Strongly agree	10 (50)	4 (20)	6 (30)	20		13 (44.8)	9 (31)	7 (24.1)	29	
	SDF is a good treatment option for carious lesions in anterior primary teeth.					**SDF is generally a good treatment to stop caries.**				
Strongly disagree	9 (45)	7 (35)	4 (20)	20		2 (66.7)	1 (33.3)	0	3	
Disagree	25 (58.1)	15 (34.9)	3 (7)	43		0	0	0	0	
Neutral	24 (50)	13 (27.1)	11 (22.9)	48	0.707	7 (63.6)	2 (18.2)	2 (18.2)	11	0.642
Agree	28 (47.5)	20 (33.9)	11 (18.6)	59		48 (45.3)	40 (37.7)	18 (17)	106	
Strongly agree	14 (45.2)	10 (32.3)	7 (22.6)	31		43 (53.1)	22 (27.2)	16 (19.8)	81	
	SDF is a good treatment option for carious lesions in anterior permanent teeth.					**SDF should be used in all patients before restorations are made.**				
Strongly disagree	45 (53.6)	25 (29.8)	14 (16.7)	84		34 (63)	12 (22.2)	8 (14.8)	54	
Disagree	29 (44.6)	23 (35.4)	13 (20)	65		37 (38.9)	38 (40)	20 (21.1)	95	
Neutral	17 (47.2)	12 (33.3)	7 (19.4)	36	0.963	22 (51.2)	13 (30.2)	8 (18.6)	43	0.115
Agree	7 (63.6)	3 (27.3)	1 (9.1)	11		4 (66.7)	2 (33.3)	0	6	
Strongly agree	2 (40)	2 (40)	1 (20)	5		3 (100)	0	0	3	
	SDF can be used to stop cavitated carious lesions.					**SDF should be used before placement of all restorations in at-risk patients.**				
Strongly disagree	1 (25)	2 (50)	1 (25)	4		13 (65)	5 (25)	2 (10)	20	
Disagree	4 (36.4)	5 (45.5)	2 (18.2)	11		23 (41.1)	18 (32.1)	15 (26.8)	56	
Neutral	13 (54.2)	8 (33.3)	3 (12.5)	24	0.886	42 (53.2)	25 (31.6)	12 (15.1)	79	0.306
Agree	48 (47.5)	33 (32.7)	20 (19.8)	101		16 (42.1)	15 (39.5)	7 (18.4)	38	
Strongly agree	34 (55.7)	17 (27.9)	10 (16.4)	61		6 (75)	2 (25)	0	8	
	SDF can be used to stop carious lesions that have not formed cavitation.					**In cases where it is not possible to treat all carious lesions in a single appointment, SDF application may be a good treatment option.**				
Strongly disagree	4 (33.3)	6 (50)	2 (16.7)	12		2 (66.7)	1 (33.3)	0	3	
Disagree	16 (57.1)	7 (25)	5 (17.9)	28		3 (33.3)	3 (33.3)	3 (33.3)	9	
Neutral	23 (63.9)	10 (27.8)	3 (8.3)	36	0.456	28 (56)	13 (26)	9 (18)	50	0.757
Agree	35 (46.7)	26 (34.7)	14 (18.7)	75		50 (45.9)	40 (36.7)	19 (17.4)	109	
Strongly agree	22 (44)	16 (32)	12 (24)	50		17 (56.7)	8 (26.7)	5 (16.7)	30	

SDF: Silver Diamine Fluoride, ‡Pearson Chi-square, Bold font: $P < 0.05$

DISCUSSION

This study investigated the training needs, clinical practices, perspectives on the advantages and disadvantages, and attitudes toward SDF among a Pediatric Dentists who are members of the Turkish Society of Pediatric Dentistry. The findings offer significant insights into the potential use of SDF in pediatric dental care.

While 98.5% of participants were aware of SDF, only 28% had used it in their clinical practice. This gap between awareness and usage suggests a need for more comprehensive training and exposure to build confidence in SDF's application. Despite low usage, many participants expressed interest in using SDF in the future. This increased interest may reflect greater awareness generated by the survey.

When comparing our findings with similar studies, Robaian et al.[13] reported a slightly lower awareness level, with 92.6% of dental practitioners having heard of SDF. In Vietnam, Chai et al.[15] showed that 77% of participants were aware of SDF, and 39.6% had previously applied it in practice. Interestingly, in Japan, Chai et al.[14] reported that 100% of the participants in their study had used SDF. This significant difference may be due to the fact that SDF has been commercially available in Japan since the 1970s, giving Japanese practitioners a much longer period to integrate it into their practices. In contrast, the commercial availability of SDF in Turkey has only started more recently, which may explain the lower application rates in our study. Similarly, Serna-Munoz et al.[16] reported that only 26.1% of participants had previously used SDF in Spain, which is a rate quite close to the present study. Salerno et al.[17] reported that 20.6% of the dentists in Italy had indicated they were using SDF. The reason could be that SDF has only been available in the Italian market for the past 5 years.

SDF has been employed for numerous clinical purposes, including reducing tooth sensitivity, preventing root caries in the elderly, and disinfecting infected root canals, its primarily used for arresting dental caries in primary teeth and preventing fissure caries in permanent molars.[6]

Although the FDA has approved SDF as a desensitizing agent, in our study, 7.5% of participants had used SDF for managing tooth sensitivity. This is notably lower than the findings of Robaian et al.[13] where 52.8% of participants had used SDF for sensitivity, and Mario B. et al.[12], where 38% reported similar use. However, in these studies as well, SDF was more frequently used for managing dental caries rather than for tooth sensitivity.[12,13] This difference suggests that our participants mainly used SDF to arrest the progression of dental caries rather than to prevent tooth sensitivity. It could also reflect that pediatric dentists in our study focus more on caries management than on addressing tooth sensitivity directly.

A significant majority of participants (85.5%) expressed the need for further SDF training, particularly among those with less experience, emphasizing the importance of continuous professional development. Interestingly, SDF usage was higher among less experienced practitioners, possibly due to recent training or openness to new treatments.

Those who applied SDF during or after postgraduate training used it more frequently, suggesting that incorporating SDF into advanced educational curricula could improve its clinical uptake. However, overall usage remained low, likely due to hesitancy or lack of confidence in its application.

More than half of the participants preferred the 38% concentration of SDF, aligning with the American Academy of Pediatric Dentistry (AAPD) workgroup panel's recommendation of utilizing 38% SDF for arresting carious lesions in primary teeth. This recommendation is classified as conditional, based on low-quality evidence.[18]

The present study revealed that awareness and experience with SDF do not significantly differ across various workplace settings, such as private practices, university hospitals, or public health clinics. This suggests that the level of knowledge and practical experience with SDF is fairly consistent regardless of the workplace environment.

In previous studies, comparisons regarding knowledge and attitudes toward SDF have primarily been made between general dentists and/or dental students.[13-17,19-23] Unlike these studies, this research focused exclusively on pediatric dentists, evaluating differences based on their levels of clinical experience and practice settings. Furthermore, general dentists and dental students were not included in the assessment of SDF-related knowledge, as it was anticipated that their limited familiarity with the subject could compromise the reliability and validity of the findings.

Nearly half of the participants agreed that SDF had a taste that was undesirable to the child. Other studies have also noted that SDF has an unpleasant and metallic taste.[5,14] The results of the current study indicate that pediatric dentists generally hold a positive view of SDF's applicability. Most dental professionals felt SDF easy to apply, non-invasive, and quick to administer. These findings were similar to existing studies.[14,15,17] SDF treatment is a straightforward and time-efficient strategy for caries control. However, they reported that a significant disadvantage is the black staining caused by SDF on treated teeth, skin, clothing, and operating room surfaces.[5,14,18]

One of the major concerns with SDF application was tooth discoloration. The study reveals that most participants do not use agents for coloration after SDF application, but those who did used potassium iodide. The statistically significant difference in approaches to managing discoloration highlights the variability in clinical practices and underscores the need for more research and consensus on effective methods to mitigate this issue.

The majority of participants across all experience levels agree that SDF was effective in preventing caries, but there was a significant difference based on the duration of experience. Less experienced practitioners tend to have a higher rate of agreement, while more experienced practitioners show a more varied response, including neutrality and disagreement. This trend suggests that experience may influence perceptions of SDF's effectiveness, potentially due to differing levels of exposure to and familiarity with alternative treatments or a deeper understanding of the complexities involved in caries prevention.

Conversely, a significant majority agreed that SDF can arrest cavitated carious lesions. In another study, the participation rate was 61%.[13] Additionally, in a separate study, 85% of participants agreed that SDF is effective for cavitated enamel lesions, while 80% supported its effectiveness for cavitated dentin lesions.[12] Agreement was lower for non-cavitated lesions, with 62.2% of participants considering SDF to be effective. In a similar study, this percentage was reported as 53.4.[13]

While the chairside guidelines from the AAPD recommend that removing carious dentin before SDF application is not required, views on this matter vary.[18] Opinions on this matter were divided in our study. While 43.8% of participants agreed that infected soft dentin should be removed prior to SDF application, 30.8% disagreed. In comparison, Serna-Munoz et al.[16] reported a similar agreement rate of 42.8%, aligning closely with the findings of this study. Robaian et al.[13] reported a slightly lower agreement rate of 34.8%, while Mario et al.[12] showed a much lower agreement rate of 14%, differing significantly from our results.

40% of participants agreed that SDF is cost-effective, whereas agreement rates in other studies were 37%[15] and 80%[14]. The lower participation rate regarding the affordability of SDF compared to the Japanese study may be attributed to limited access to SDF, a restricted number of products available on the market (potentially increasing costs), or income disparities between countries. The participation rate for the option SDF should be used before the placement of all restorations in at-risk patients was 46%, compared to 24.5%[19] and 59%[14] in other research. Both our study and the studies by Mario et al.[12] with pediatric dentists, as well as Nelson et al.[11] study involving pediatric dentistry program administrators, demonstrated a high level of agreement that SDF is indicated for the treatment of patients with behavioral difficulties and medically fragile individuals.

Early Childhood Caries is frequently observed in preschool-aged children, and restorative treatments for children with special needs can be particularly challenging, as they often become restless. This commonly necessitates moderate sedation or general anesthesia.[19] SDF has emerged as a promising option for managing these patients, gaining substantial approval from parents and caregivers.[20] Among the participants, 43.7% of pediatric dentists prefer SDF over general anesthesia, while 26.8% remain undecided on this matter. Additionally, other research supports the use of SDF for treating anxious patients as an alternative to general anesthesia.[12,13] In the study by Seifo et al.[27], SDF's ease of application was highlighted as making it suitable for older children, adults with medical or psychological limitations, and those with dental phobias, and that this benefit could potentially reduce the need for general anesthesia in some patients.

Overall, these results suggest a generally positive perception of SDF treatment across various scenarios, especially for patients with special needs, severe anxiety, or other complications that make traditional treatment challenging. This indicates broad recognition of SDF's efficacy in managing carious lesions, despite some reservations about specific applications.

Another distinguishing feature of the current study is the inclusion of multiple-choice questions regarding SDF application protocols. Although various guidelines exist, there is currently no universally accepted standard protocol for SDF application. The development of an evidence-based, standardized protocol would require further high-quality research. Establishing a clear protocol could facilitate the integration of SDF more rapidly into dental curricula and enhance knowledge dissemination among practitioners, as similarly suggested by Jakubauskas et al.[21] One possible reason for the current lack of consensus on application protocols is the variability in product compositions and manufacturer instructions across different SDF brands.

The broader acceptance of SDF among pediatric dentists could significantly benefit the prevention and treatment of dental caries. Our study shows that a large proportion of dental professionals acknowledge the effectiveness of SDF in preventing caries. However, concerns about aesthetics and potential toxicity may hinder its more widespread use. Therefore, further education and information dissemination are necessary to address these issues.

This study has some limitations, including the small sample size and potential biases in self-reported data. Moreover, response rates for web-based surveys are

often low due to the high volume of junk emails people receive.[28] Nonetheless, our study provides a valuable perspective on pediatric dentists' views on SDF, contributing significantly to the field. Numerous studies, clinical trials, and systematic reviews show that the use of SDF effectively halts or prevents the progression of carious lesions in a significant proportion of cases.[29-31] Future research should explore the long-term effects of SDF and investigate strategies to mitigate aesthetic concerns. Broadening studies to different regions and demographic groups will help better understand SDF's role in pediatric dentistry. It is also crucial to design educational programs that improve dental professionals' knowledge and application skills regarding SDF.

CONCLUSIONS

Overall, while SDF is widely recognized among dental professionals, there were discrepancies between awareness, application, and training needs. No different trends in SDF use and perceptions were observed among dental professionals in different workplace settings. This suggests a relatively consistent approach to SDF usage and attitudes across various dental practice environments.

Overall, while there were some variations in perceptions, particularly regarding effectiveness and clinical application, the general consensus among dental professionals was positive towards the use of SDF across different experience periods.

There was a consensus on the need for further training in SDF application, indicating an opportunity for educational interventions in the dental community.

Further research and educational efforts may be beneficial to enhance the utilization of SDF in clinical practice and address any concerns or uncertainties surrounding its application.

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CONFLICT OF INTERESTS

None

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