

ASSESSMENT OF EDUCATION, KNOWLEDGE, AND ATTITUDES OF PEDIATRIC DENTISTS ABOUT SILVER DIAMINE FLUORIDE IN A COUNTRY WITHOUT OFFICIAL APPROVAL FOR IT AS A PREVENTIVE TREATMENT

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ABSTRACT:

Objectives: The aim of this study is to assess the Silver Diamine Fluoride (SDF) knowledge, attitudes, and experiences of pediatric dentists in Turkey and explore the relationships between participants' demographic characteristics and their education, knowledge level, and attitudes towards SDF.

Methods: In this cross-sectional study, 245 pediatric dentists answered an online questionnaire about SDF, which was created electronically (Google Forms) and consisted of four parts, between January to March 2021.

Results: The mean age was 33.9 ± 8.4 (24–70) years and the mean duration of experience as a pediatric dentist was 5 (1–35) years. When the participants were analyzed according to age and academic status, the majority of the participants were aged from 24 to 35 years (69.3%) and were specialists without academic titles (62%). Of the participants, 65.7% were employed in university and state hospitals. Among the participants, 80.4% expressed that they gained their knowledge and educational experience on SDF from dental journals and other publications during their professional life. The correlation analysis revealed a negative correlation between age and education score ($p < 0.001$, $r = -0.362$) and a positive correlation between age and knowledge score ($p < 0.001$, $r = 0.229$). Although there was a statistically significant difference in SDF education scores between specialists without academic titles and academics in favor of the specialists ($p < 0.001$), academics had higher knowledge scores than non-academic specialists ($p < 0.001$). When the education, knowledge and attitude scores was analyzed, a positive correlation was found between knowledge and attitude scores ($p < 0.001$, $r = 0.507$). With logistic regression, it was found that academics tended to use SDF 2.6 times (1.22–5.40) more than non-academic participants and women 2.3 times (1.07–4.76) more than men in future.

Conclusions: Providing adequate clinical and theoretical knowledge about SDF during dental medicine education may help pediatric dentists in increasing the preference rates of SDF in clinical practice.

Keywords: Child; Fluorides; Pediatric Dentists; Silver Diamine Fluoride; Surveys and Questionnaires; Topical;

INTRODUCTION

Dental caries is one of the most significant public health problems that is believed to affect social health care policies worldwide and occurs in 60–90% of school-age children.¹ Early childhood caries (ECC) is considered one of the most common

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chronic diseases in early childhood, and several studies show that ECC is neglected and often untreated.² The prevalence of caries in children is also quite high in Turkey. Studies conducted in different parts of the country found the prevalence of caries to range from 64.9% to 82.6%.³⁻⁵ It is known that well-planned policies should be implemented to reduce these rates.

Fluoridation of drinking water is considered by many to be an economical and effective caries prophylaxis method.⁶ However, the amount of fluorine to be added to drinking water should be adjusted according to the fluorine concentrations of the natural drinking and spring waters in the residential areas, the average daily amount of water consumed in the region, and other fluorine prophylaxis programs being applied. Especially the existence of other factors (diet, climate, altitude, socio-economic structure, etc.) affecting dental fluorosis should not be forgotten.⁷⁻⁹ Previous studies reported that the incidence of mild or moderate fluorosis cases has increased in many countries in recent years, due to the use of fluoridated drinking water and also various fluorine-containing products.¹⁰⁻¹² In general, the ideal daily dose of fluoride, which provides protection from tooth decay and which historically has not been considered to pose a systemic risk to individuals, has been reported as 1 ppm (1 mg/L water). Recent studies on fluoride-induced developmental neurotoxicity raise a query about whether 1 ppm of fluoride in drinking water is safe for pregnant women. While the fluorine concentration in the surface layer of a newly erupted tooth is around 800 ppm, it is reported that a fluoride concentration of at least 1000 ppm should be present in the surface layer of a caries-resistant tooth, and therefore topical fluoride applications are thought to be beneficial in erupted teeth. However, careless use of topical agents also increases the risk of dental fluorosis. To avoid the risk of fluorosis, products containing fluoride should be used under the supervision of professionals, especially in children aged six years and younger. In this way, paying attention to isolation and not swallowing the preparations during applications will greatly minimize the risk of acute and chronic fluoride toxicity. Dentists, educators, manufacturers, and families should be trained in this regard.

Recently, it has become a prevalent opinion that preventive treatments should be prioritized to avoid dental treatment. Fluoride, an important material used in preventive treatments, can be applied individually at home / school or professionally by dentists at higher concentrations. Topical application of silver diamine fluoride, which is one of the methods for caries arrest, is receiving a great deal of interest due to its effective protection, relatively low cost, and ease of implementation.¹³⁻¹⁵ Through such features, it facilitates access to oral health services, allows oral health to reach the optimum level, and reduces the need for emergency care and treatment.¹⁶ Silver diamine fluoride (SDF) was developed in the late 1960s to combine the antibacterial properties of silver ions and the protective effects of fluoride.¹⁷ SDF was approved for clinical use by the Central Pharmaceutical Council of the Ministry of Health of Japan approximately 40 years ago and by the United States Food and Drug Administration in March 2015.^{18,19} Afterwards, the use of SDF has been increasingly adopted in many countries.

The available formulation, 38% SDF, has one of the highest concentrations of fluoride ions among all topical applications, with 44,800 ppm of fluoride, as compared to 22,600 ppm in 5% NaF varnish.¹⁷ SDF is known to be effective

especially in preventing and treating childhood caries. It is also reported that it can be used to prevent coronal and root caries in adults with difficult access to treatment.

However, the tooth discoloration caused by the SDF application is considered the biggest disadvantage, which influences the acceptability of this treatment for anterior teeth among parents. For such reasons, the public should be well informed about the advantages of SDF in caries prevention. It is believed that this information can be provided most accurately by dentists, especially pediatric dentists.¹⁸ In 2016, Nelson et al. reported that 79.9% of pediatric dentistry residency programs in the USA started to include SDF-related content in their curricula, and it was used in one-fourth of the clinical programs.²⁰ Studies conducted in various countries to assess the knowledge and attitudes of dentists about SDF have reported that the knowledge and attitudes of dentists should be improved, SDF should be more commonly taught in undergraduate programs, and accessible simplified resources should be available for clinicians' access, and there is a need for training to improve knowledge on the accurate use, benefits, and limitations of SDF.^{18,20, 21} There is no study conducted in Turkey assessing how effectively the undergraduate and doctoral curricula have provided information on SDF applications to the pediatric dentists, through which channels they have started to receive information after their doctoral program, and to what extent they prefer SDF applications in their clinical practice.

The primary purpose of the present study is to examine the SDF knowledge, attitudes, and experiences of pediatric dentists in Turkey. The secondary purpose of the study is to explore the relationships between participants' age, clinical title, status and location of the affiliated institution, and their education, knowledge level, and attitudes towards SDF.

MATERIALS AND METHODS

This cross-sectional survey study was conducted between January and March 2021 to assess the knowledge levels, attitudes, and experiences of pediatric dentists about SDF in compliance with the Declaration of Helsinki after obtaining approval from the ethics committee of the University of Health Sciences Non-Invasive Clinical Research Ethics Committee (Decision No: E-46418926-050.01.04--8408, Date: 29 January 2021). All study participants were informed of its content and confirmed their voluntary willingness by signed a written consent before the filling the questionnaire. The questionnaire, which was created electronically (Google Forms) and consisted of four parts, was sent via E-mail with a link to 600 pediatric dentists across the country who were registered with the Turkish Society of Pediatric Dentistry. Sample size of the study was calculated as a minimum of 235 individuals with a 95% Confidence Interval, design effect of 1, prevalence of 50% and margin of error of 5%, using the following formula: Sample size, $n = [DEFF * Np(1-p)] / [(d2 / Z21 - \sqrt{2 * (N-1) + p * (1-p)}]$. After the respondent completed the questionnaire and sent it back to the database, the questionnaire was checked for completeness so that it could be included in assessment. Incomplete questionnaires were returned to the relevant respondent with a request that they complete the missing parts.

The first part of the four-part questionnaire collected data on sociodemographic characteristics of the participants (title, age, sex, affiliated institution, years of

experience as a pediatric dentist and the city traffic code of the affiliated institution). The second part included questions on survey participants' education on SDF during undergraduate and doctoral/residency programs and the sources of information used for SDF after graduation. The third part consisted of 21 questions to assess general and specific clinical knowledge of the participants regarding SDF. The fourth part included 13 questions that were developed to assess the attitudes of the participants towards SDF. This part measured the professional behaviors of the participants regarding the use of SDF in the clinical setting. A 5-point Likert-type scale was used for the multiple-choice items, and the participants were asked to rate the second part with 1- Not at all, 2- Only a little, 3- To some extent, 4- Good, 5- Very good, and the fourth part with 1- Strongly Disagree, 2- Disagree, 3- Neutral, 4- Agree, 5- Strongly agree.

Descriptive statistics were presented as mean (\pm) standard deviation, median (min-max), frequency distribution and percentage. The normality of continuous variables was analyzed using visual (histogram and probability plots) and analytical methods (Kolmogorov-Smirnov test). For categorical variables, the difference in frequency between the groups was compared using Chi-Square tests. The measurements of the non-normally distributed variables were compared using the Mann-Whitney U test between two independent groups, and the Kruskal-Wallis test between three or more groups. The measurements of the normally distributed variables were compared using the Independent Samples t-test (Student's t-test) between two independent groups, and the ANOVA between three or more groups. The Bonferroni correction was used for the comparison of multiple groups. The Spearman's correlation analysis was conducted to assess the relationships among continuous variables. Correlation coefficients were interpreted as follows: (r) 0.0–0.19: "very weak", 0.20–0.39: "weak", 0.40–0.59: "moderate", 0.60–0.79: "strong", and 0.80–1.00: "very strong". The future use of SDF was predicted by conducting a multiple logistic regression analysis with the backward method. The level of statistical significance was set at $p < 0.05$. The study data were assessed using SPSS 25.0 statistical package.

RESULTS

Women accounted for 80.8% (n=198) of the 245 Turkish Society of Pediatric Dentistry members participating in the study. The mean age was 33.9 ± 8.4 (24–70) years and the mean duration of experience as a pediatric dentist was 5 (1–35) years. When the participants were analyzed according to age and academic status, the majority of the participants were aged from 24 to 35 years (69.4%) and were specialists without academic titles (62%). Of the participants, 65.7% were employed in university and state hospitals. Details of demographic characteristics are presented in Table 1.

Among the participants, 80.4% expressed that they gained their knowledge and educational experience on SDF from dental journals and other publications during their professional life. This was followed by online sources (60.8%), dental organizations (34.3%) and continuing education courses (10.6%), respectively (Figure 1). On the other hand, almost three-quarter of the participants expressed that they did not acquire any knowledge on SDF in theoretical courses during their education in dentistry faculties, as compared to 63.7% of those with residency training. Only 5.3% of the participants stated that they received clinical training

about SDF during their undergraduate education, as compared to 14.3% during residency training (Figure 1).

Table 1. Demographic characteristics of participants

		N	%
Gender	Female	198	80.8
	Male	47	19.2
Age	24-35	170	69.4
	36-45	52	21.2
	> 45	23	9.4
Title	Specialist	152	62
	Academicians	93	38
Workplace	University	151	61.6
	Partnership/Group practice	44	18
	Solo practice	32	13.1
	Public	10	4.1
	Private hospital dentistry	8	3.3
Work place region	Mediterranean	19	7.8
	Aegean	18	7.3
	Marmara	117	47.8
	Eastern Anatolia	20	8.2
	Central Anatolia	56	22.9
	Southeastern Anatolia	1	0.4
	Black Sea	14	5.7

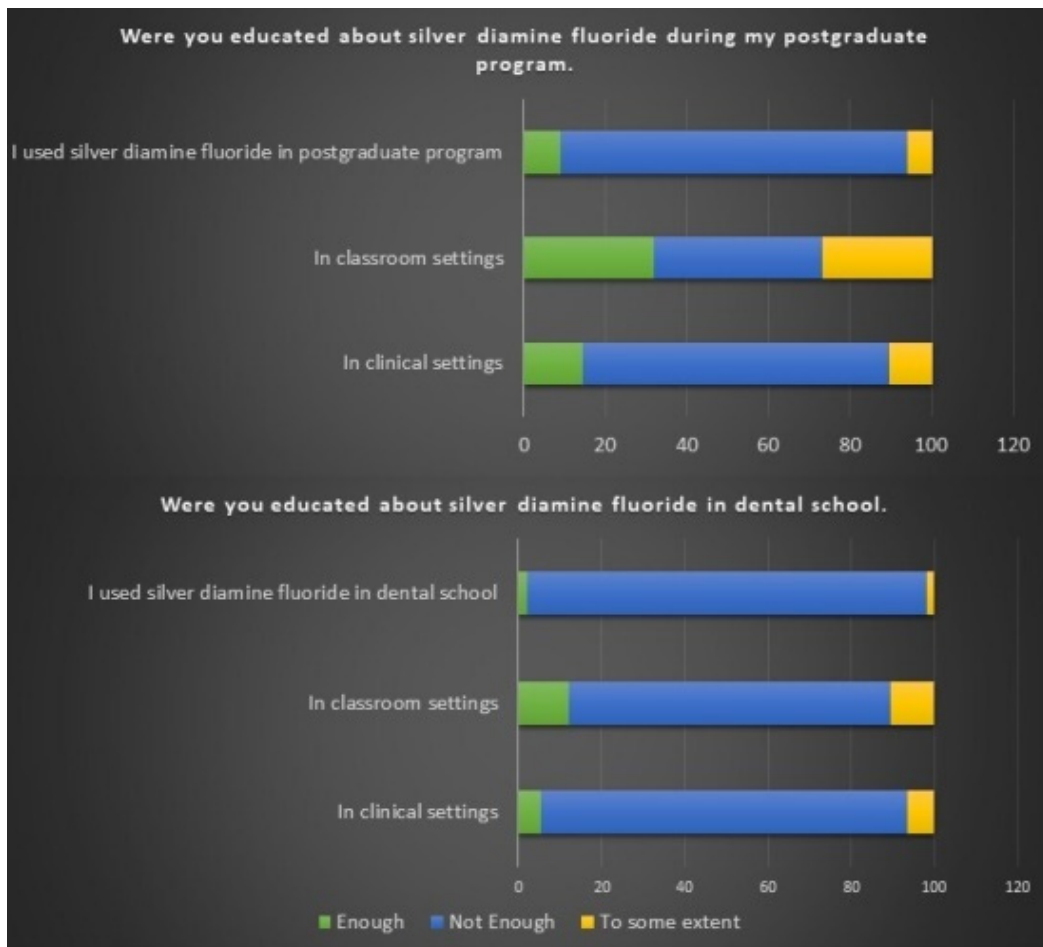


Figure 1. Participants' responses about their silver diamine fluoride (SDF) educational experiences, by percentage of respondents to each item

When the responses to the six questions used to assess the knowledge score on SDF were examined, the majority (68.6%) expressed that they knew well what SDF was used for in dentistry, 58.8% were aware of the advantages of SDF treatment over conventional dental treatments, and 61.6% were found to have full knowledge of the potential side effects of SDF treatments.

Nine questions were included to assess participants' knowledge on the use of SDF to treat carious lesions (Table 2A). While 72.3% of the respondents expressed that SDF could be used to treat cavitated enamel lesions, the rate of those with a positive opinion that it could be used to limit the cavitated dentin lesions was 63.6%.

Only 37.9% of the participants believed that infected dentin should be removed before SDF application. Regarding non-cavitated lesions, 66.5% agreed that SDF could limit the enamel lesions.

When the participants were asked for their opinions about the use of SDF before restoration, 78% argued that SDF should be used before all restoration procedures, while 24.5% expressed that SDF should be used in patients at risk. The rate of those

who stated that SDF could be used to arrest caries if all restorations could not be finished in a single session was 74.7%.

Table 2A. Participants' responses about their silver diamine fluoride (SDF) knowledge, by percentage of respondents to each item. (Response options were 1- Strongly Disagree, 2- Disagree, 3- Neutral, 4- Agree, 5- Strongly agree)

	Response					Mean	SD
	1	2	3	4	5		
How much do you disagree/agree with the following statements?							
SDF can be used to arrest cavitated lesions in enamel.	3.7%	8.2%	15.9%	22.9%	49.4%	4.06	(1.15)
SDF can be used to arrest cavitated lesions in dentin.	4.1%	15.5%	16.7%	21.6%	42%	3.82	(1.25)
SDF can be used to arrest cavitated root caries.	7.3%	14.3%	20.8%	16.7%	40.8%	3.69	(1.33)
Infected soft dentin must be removed prior to applying SDF.	14.3%	21.6%	26.1%	21.6%	16.3%	3.04	(1.29)
SDF is a good tx for arresting caries when it is not possible to restore all lesions in one appointment.	1.2%	7.3%	16.7%	29.8%	44.9%	4.1	(1.01)
SDF can be used to arrest non-cavitated lesions in enamel.	6.9%	11%	15.5%	21.2%	45.3%	3.87	(1.29)
SDF can be used to arrest non-cavitated root caries.	6.9%	9.4%	22.9%	19.6%	41.2%	3.79	(1.27)
SDF should be used prior to placing all restorations in all patients.	52.7%	25.3%	11%	6.5%	4.5%	1.85	(1.13)
SDF should be used prior to all restorations in at-risk patients.	14.3%	20.8%	40.4%	15.9%	8.6%	2.84	(1.12)

The questionnaire included six items to assess the level of knowledge on the desirable and undesirable factors for the use of SDF in patients (Table 2B). The majority (91.4%) had the opinion that SDF was only suitable for professional applications. While 72.3% expressed that they had a positive opinion about the level of evidence supporting the safety and efficacy of SDF, there were participants considering permanent black staining of the teeth (84.2%), the inability to restore the natural tooth anatomy with the use of SDF without restoration (80.8%) and the cost to the patients (36.7%) as barriers. Despite these reservations, the rate of those who

Table 2B. Participants' responses about their silver diamine fluoride (SDF) knowledge, by percentage of respondents to each item. (Response options were 1- Strongly Disagree, 2- Disagree, 3- Neutral, 4- Agree, 5- Strongly agree)

	Response					Mean	SD
	1	2	3	4	5		
Permanent black discoloration on tooth after treatment.	0.4%	4.9%	10.6%	20.8%	63.3%	4.42	(0.90)
The fact that SDF treatment does not restore natural tooth anatomy, function, if it is not followed by a restoration.	0.8%	5.7%	12.7%	17.1%	63.7%	4.37	(0.97)
The procedure is comfortable for the patient and the physician..	2.9%	2.4%	22.9%	23.7%	48.2%	4.12	(1.03)
SDF can only be applied under the supervision of a professional.	0.4%	1.6%	6.5%	15.1%	76.3%	4.65	(0.71)
The safety and efficacy of SDF have been proven.	0%	3.3%	24.5%	33.1%	39.2%	4.08	(0.87)
Low cost to the patient	6.1%	13.9%	43.3%	16.3%	20.4%	3.31	(1.13)

When asked about the use of SDF in non-esthetic areas due to the black staining of the teeth, 94% of the participants stated that they could use this substance for primary teeth, while this rate decreased to 68.5% for permanent teeth. Despite this side effect, the rate of those who stated that SDF could still be used for primary and permanent teeth even in esthetic areas was 11% and 2.4%, respectively.

When questioned about the use of SDF to arrest caries in primary and permanent teeth, the rate of those who stated that they often used it for caries prevention in non-esthetic areas of primary teeth was 91%, while the rate of those who stated that they often used it in non-esthetic areas of permanent teeth was 68.5% (Figure 2). The rate of those who stated that they would like to include SDF more frequently in their daily practice was 80.4%

Table 3 shows the responses to the questions about the indications for SDF in specific patients. The majority of the respondents argued that SDF should be used especially in children with behavioral problems (87.8%), patients with severe anxiety (83.3%), and patients with the need for general anesthesia due to cooperation problems but also with conditions that would be a barrier to such administration (77.1%)

Table 3. Participants' responses to the questions about the indications for SDF in specific patients, by percentage of respondents to each item. (Response options were 1- Strongly Disagree, 2- Disagree, 3- Neutral, 4- Agree, 5- Strongly agree)

	Yes (%)	No (%)
SDF is a good treatment alternative		
For restorations in children with behavioral issues	87.8	12.2
When patients are medically fragile.	57.6	42.4
When patients have severe dental anxiety.	83.3	16.7
When patients are undergoing or have recently undergone radiation therapy or chemotherapy.	67.8	32.2
When patients take bisphosphonate medications.	35.1	64.9
If patients would have to be put under general anesthesia for their dental treatment otherwise.	30.6	69.4
If patients would be unable to receive normal dental treatment and could also not be put under general anesthesia for treatment.	77.1	22.9
If patients with microstomia have difficult to access lesions that require treatment.	39.2	60.8
None	1.6	98.4

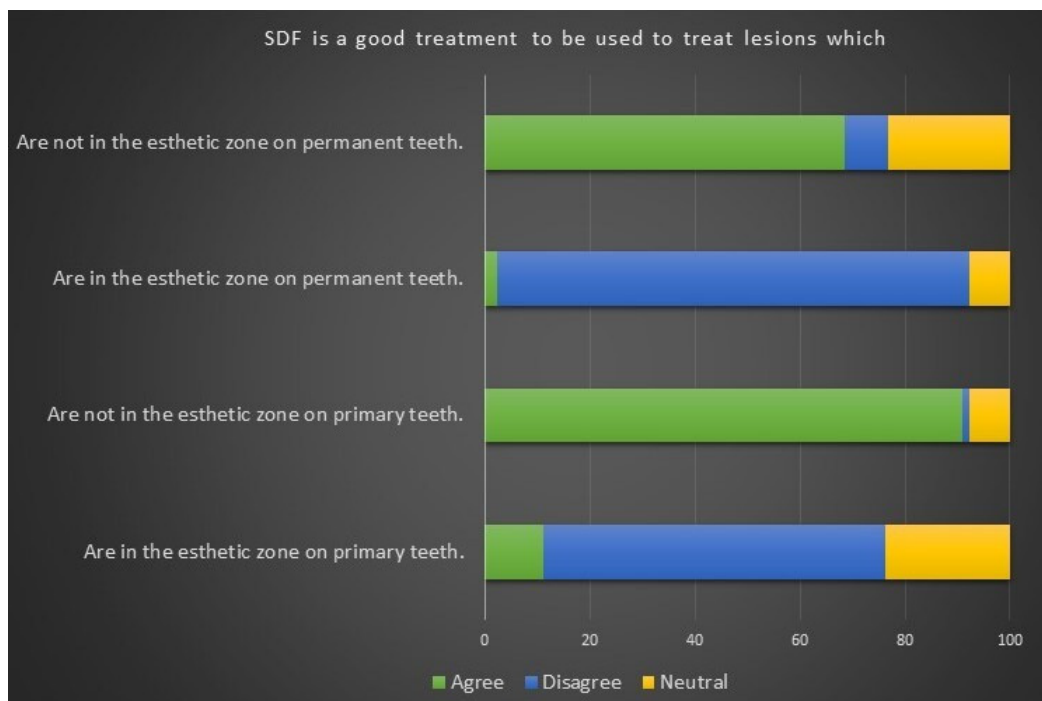


Figure 2. Participants' responses regarding silver diamine fluoride (SDF) considerations/attitudes, by percentage of respondents to each item

The correlation analysis revealed a weak negative correlation between age and education score ($p < 0.001$, $r = -0.362$) and a weak positive correlation between age and knowledge score ($p < 0.001$, $r = 0.229$) (Table 4). When the relationship between education, knowledge and attitude scores was examined, there was a moderate positive correlation between knowledge and attitude scores ($p < 0.001$, $r = 0.507$) (Figure 3).

Although there was a statistically significant difference in SDF education scores between specialists without academic titles and academics in favor of the specialists ($p < 0.001$), academics had higher knowledge scores than non-academic specialists ($p < 0.001$).

The questionnaire scores did not statistically significantly differ according to the status and the location of the affiliated institution. Although the group over 50 years of age had the highest mean attitude scores from the questionnaire, there was a statistically significant difference only between the age groups of 50 years and 36–49 years ($p = 0.039$). When the factors influencing the future use of SDF were analyzed by logistic regression, it was found that academics tended to use SDF 2.6 times (1.22–5.40) more than non-academic participants and women 2.3 times (1.07–4.76) more than men (Table 5).

Table 4. Correlation analysis between age, economic development, education, knowledge and attitude levels

		N	Age	Economic development	Education scores	Knowledge scores
Economic development	r (P)	245	0.264 (<0.001)			
Education scores	r (P)	245	-0.362 (<0.001)	-0.037 (0.561)		
Knowledge scores	r (P)	245	0.229 (<0.001)	0.271 (<0.001)	0.115 (0.072)	
Attitude scores	r (P)	245	0.039 (0.543)	0.118 (0.066)	0.111 (0.082)	0.507 (<0.001)

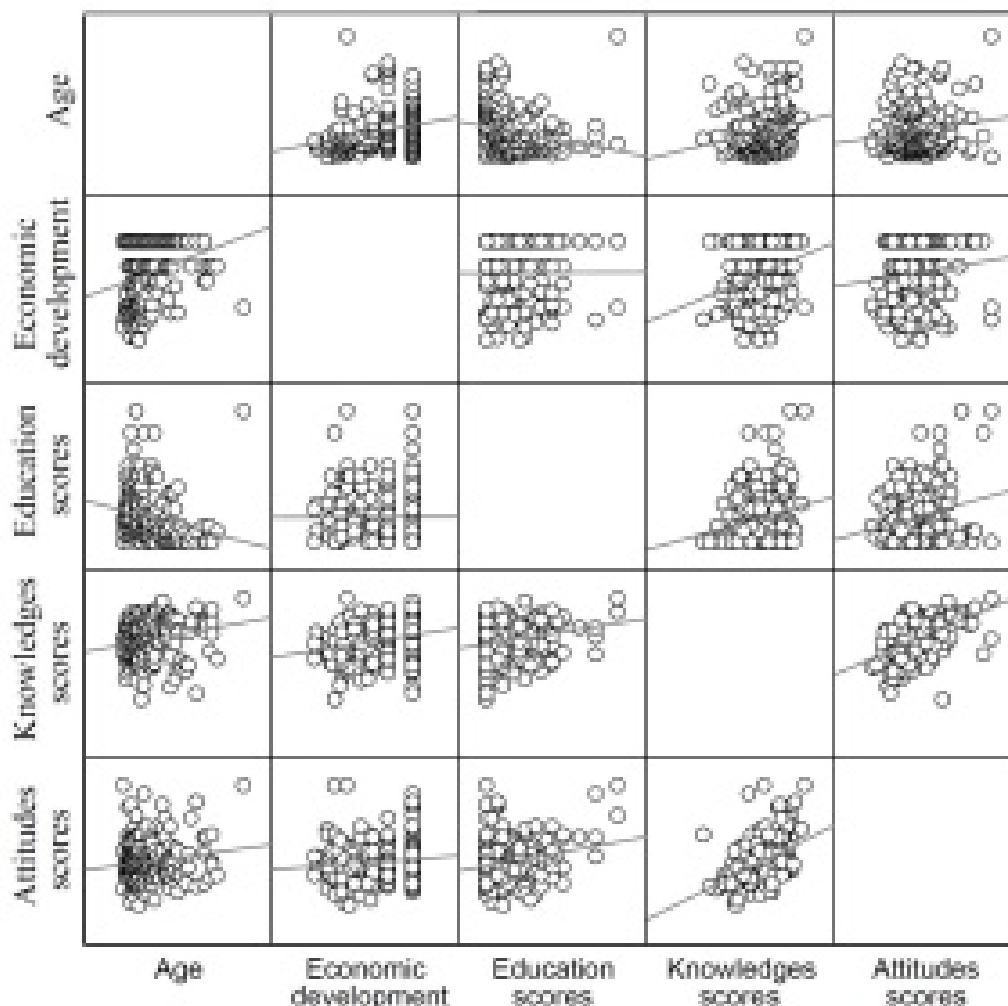


Figure 3. Scatter plot matrix illustrating relationships between all pairs of variables.

Table 5. Logistic regression model of factors affecting future usage of SDF (OR = odds ratio; CI = confidence interval; SE = standard error)

	B	SE	Wald's	OR	95% CI for OR		p
					Lower	Upper	
Title (ref=specialist) Academicians	0.944	0.379	6.213	2.6	1.22	5.40	0.013
Gender (ref=Male) Female	0.814	0.38	4.587	2.3	1.07	4.76	0.032

DISCUSSION

The present study assessed education, knowledge levels and attitudes of pediatric dentists in Turkey about silver diamine fluoride. The pediatric dentists who participated in the study were found to receive limited training on SDF during their theoretical and clinical training. Nevertheless, knowledge and attitude scores revealed that they continued their development on this subject by utilizing various sources after graduation. The participants with academic titles were observed to have higher knowledge and attitude scores. These high scores showed that the participants with academic titles had a greater tendency to use SDF in the future than non-academic specialists.

Our study determined that approximately three-quarter of the participants had never had the opportunity to use SDF during their undergraduate and residency programs in dentistry. These findings are not surprising because SDF was not approved by the FDA for the treatment of dentin sensitivity until 2014, and it is not included in routine practice in Turkey because SDF has not yet been approved by the Turkish Ministry of Health.^{14,22} Even after the FDA approval, SDF was initially used in developed major cities with a high level of welfare, and it has taken a long time to reach rural areas with insufficient health care services.²³

The increased educational experience in pediatric dentistry residency programs compared to dental education is also not surprising, since one of the main target populations for the use of SDF is children.²⁰ Upon the AAPD's approval of the use of SDF, it is believed that SDF practice training in pediatric dentistry residency programs will continue to increase over time.²⁴

In our study, when the participants were asked about the stage to intervene in carious lesions with SDF, the majority expressed that it could be used for cavitated enamel and dentin lesions, while 66.5% stated that it could also be applied to the non-cavitated enamel lesions. The rates reported by Antonioni et al. were 85% for cavitated lesions and 64% for non-cavitated lesions, while Alajan et al. found these rates to be 50.4% and 58.5%, respectively.

According to the American Dental Association (ADA) guidelines, SDF is recommended for use to arrest severely cavitated lesions in primary teeth and

occlusal caries in permanent teeth.²⁵ Previous studies have supported the use of SDF as a protective agent against new carious lesions in primary teeth and permanent molars.¹⁴ The efficacy of SDF in caries arrest is believed to improve through its high concentrations of silver and fluorine ions, alkalinity and synergistic effect of these ions.^{26,27} Dos Santos et al. showed the SDF application to have a similar effect to a low-viscosity glass ionomer, which releases high free fluorine ions, in arresting active dentin lesions in primary teeth.²⁸

In this study, 37.9% of the participants believed that infected dentin should be removed before SDF application. According to the study by Chu et al., 14% of the participants expressed that infected soft dentin should be removed before SDF application, while 17% remained neutral in this regard.²⁹ The study of Antonioni et al. found this rate to be 59%.¹⁸

In our study, when the use of SDF before all restorations was questioned, 78% of the participants stated that it should be used in patients at risk. In the study by Alajlan et al., 47.1% of the participants stated that SDF should be used before all restorations.²¹ In another study, very few of the participants (3%) preferred SDF placement before all restorations, while 9% reported that they considered SDF placement necessary before restorations in patients at risk.^{30, 31}

According to the majority of the participants, SDF treatment does not restore natural tooth anatomy and function unless it is completed with a restoration, which is a major obstacle. Despite parents' intolerance to black staining, it is believed that they will accept the SDF application to avoid extensive treatments such as general anesthesia or sedation.¹⁵ In our study, despite the permanent black staining of the tooth after treatment, most of the participants considered SDF a comfortable solution for both the patient and the physician.

The majority of our study participants agreed that SDF is a good treatment alternative to restorations in children with behavioral problems, patients with medical problems, and patients with high anxiety. The study by Crystal et al. reported that the parents of patients with physical or behavioral disabilities were more willing to accept the SDF application instead of treatment under general anesthesia.³² In two different studies conducted in accordance with the American Academy of Pediatric Dentistry guidelines, more than half of the participants agreed that SDF is a good alternative treatment for individuals with behavioral or medical problems.^{18,33}

Regarding the cost of SDF, 36.7% of our study participants found it advantageous. Considering the low cost of SDF, the short application time in the clinic, and the caries preventive effect of the treatment, SDF is a material that is currently the focus of dentists' attention.³³ In a study on the use of SDF, Dos Santos et al. reported the cost of high-viscosity glass ionomer used in atraumatic restorative therapy (ART) to be almost 20 times higher than SDF.²⁸ In countries with low socioeconomic levels, the SDF application, which is a caries arresting material, stands out instead of high-cost restorative treatments.³⁴ In another study examining the economic outcomes of using SDF, only 20.86% of respondents considered the cost of SDF a barrier, and 39.9% remained neutral on this issue.²¹

Permanent discoloration occurs after SDF application³³. Before SDF application, collagen structure is exposed in the dentin of the caries lesion. After the application,

only the carious dentin is stained black, while the intact areas remain unstained. The black stained layer was reported to be a hard and low-permeable silver phosphate layer.^{19,35} Some researchers suggested using potassium iodide to reduce the staining effect of SDF after application.³⁶ A recent study used nano-silver fluoride, which was found to be effective in arresting dentin caries and not to result in black staining of carious lesions.²⁸ This new agent has been demonstrated to have low toxicity to viable cells and to have antimicrobial activity against *S. mutans*, similar to that of SDF.

The discoloration of the teeth after the SDF application is one of the factors influencing the acceptability of treatment among the parents.²⁰ A previous study asked parents whether they accepted the SDF application especially for primary teeth and did not find enough evidence,³⁷ whereas the study by Crystal et al. established that parents accepted the use of SDF for posterior teeth at a higher rate than for anterior teeth.³²

However, despite parents' intolerance to black staining, it is believed that they will accept the SDF application to avoid extensive treatments such as general anesthesia or sedation.¹⁸

While the majority (91%) of the pediatric dentists participating in our survey preferred SDF as a good treatment alternative for primary teeth in the non-esthetic area, some dentists (68.5%) considered SDF a good alternative for the treatment of permanent teeth in the non-esthetic area. In esthetic areas, in turn, these rates were 11% for primary teeth and 2.4% for permanent teeth.

Studies in the literature report the rate of use by pediatric dentists to range from 33% to 37% for anterior primary teeth and from 54% to 80% for posterior primary teeth. It was determined that the rate ranged from 14.3% to 18.7% for the anterior permanent teeth, and from 57.7% to 65% for the posterior permanent teeth.^{18,21,32} The correlation analysis revealed a weak negative correlation between age and education score and a weak positive correlation between age and knowledge score. Although there was a statistically significant difference in SDF education scores between specialists without academic titles and academics in favor of the specialists, academics had higher knowledge scores than non-academic specialists. In their study, Antonioni et al. found that academics had a higher level of knowledge than non-academics and that their usage preferences decreased with increasing age. The study by Alajlan et al. compared the attitude scores according to clinical titles and established that there was no significant difference between SDF knowledge level and age, gender, clinical titles, but there was a significant correlation between knowledge and attitude scores and clinical titles.²¹ Especially the attitude scores of the residents were higher than those with other titles. Unlike the findings of Alajlan's study, in this study there was a positive correlation between age and knowledge score, while a negative relationship was found between age and education score. Similar to Alajlan's study, no significant relationship was found between all three scores and genders.

In their study, Vollú et al. reported that the use of SDF was not related to the practice location, while the preference for use was increased among private practice, pediatric dentists, and experienced dentists.³⁸ Antonio et al. also found that no

statistically significant difference was found between practice location and SDF knowledge, attitudes, and education.¹⁸ That study concluded that the knowledge score of the academicians was higher than all other groups. In line with the results of these studies, in this research, we found that there was no difference between the use of SDF and age and professional experience, and between academics and specialists but in contrast to previous works the physicians working in developed cities had higher knowledge score and there was a positive correlation between knowledge score and attitude.

In this study, when the participants were asked about their future use of SDF, 80.4% expressed that they would use it more frequently and 1.4% stated that the frequency of use would not increase in the future. Pediatric dentists with academic titles were more inclined to use SDF than non-academics, and female dentists were more inclined to use SDF than their male counterparts. In their study, Alajlan et al. examined the tendency to use in the future based on age, sex, dental specialty, and title and could not find any difference.²¹

There is no study in Turkey that measures knowledge and attitudes about silver diamine fluoride. SDF is not approved by authorities in Turkey, the level of awareness is low and dentists lack of clinical experience, all of which may affect the dentists' decisions and preferences regarding this type of treatment. Another limitation is that the scope of the survey conducted in this study was limited to pediatric dentists working in Turkey.

CONCLUSIONS

There are ongoing studies about the acceptability of SDF, the knowledge related to the material and its clinical efficacy in professional applications. The interest in this material is increasing its use across the world. Providing adequate clinical and theoretical knowledge about SDF during dental medicine education may help pediatric dentists in increasing the preference rates of SDF in clinical practice.

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CONFLICT OF INTEREST DECLARATION

The authors declare that they have no conflict of interest. The data that support the findings of this study are available on request from the corresponding author.

ETHICAL APPROVAL

Ethical approval was given by the ethics committee of the University of Health Sciences Non-Invasive Clinical Research Ethics Committee (Decision No: E-46418926-050.01.04--8408, Date: 29 January 2021)

CONFLICT OF INTEREST DECLARATION:

The authors declare that they have no conflict of interest. The data that support the findings of this study are available on request from the corresponding author.

AUTHOR CONTRIBUTIONS

Basak Kiziltan Eliacik and Meltem Karahan contributed to the acquisition, analysis, and interpretation of the data; Caner Baysan contributed to the statistical analysis of gathered data; Basak Kiziltan Eliacik wrote the draft; Mine Koruyucu contributed to acquisition of data, and interpretation of the data. Both Basak Kiziltan Eliacik and Figen Seymen contributed to the final version of the manuscript. Figen Seymen supervised the project

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