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Original Article

Parental perception of silver diamine fluoride for the management of dental caries



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المخلص

أهداف البحث: تهدف هذه الدراسة لتحديد واستخراج فهم وقبول الوالدين وضع فلورايد الفضة ثنائي الامين عند علاج تسوس الأسنان مع أهداف هي (أ) تقييم قبول الوالدين وضع فلورايد الفضة ثنائي الامين كعلاج اختياري لتسوس الأسنان لأطفالهم و (ب) دراسة مخاوف الوالدين بالنسبة لاستخدام فلورايد الفضة ثنائي الامين لتسوس اسنان الطفولة.

طرق البحث: تم إجراء مسح مقطعي باستخدام استبانة موثقة بين آباء الأطفال أعمارهم ٢-١٠، الذين تم الإبلاغ عنهم في قسم اسنان الأطفال في مستشفى أسنان بين يونيو ٢٠٢٠ ويناير ٢٠٢١.

النتائج: تضمنت الدراسة ١٩٧ مشاركا/وصبا. أظهر ١٢٨ قبولا لفلورايد الفضة ثنائي الامين. من بينهم فضل ٩٩ الأسنان الخلفية العلوية للعلاج. اعتبر ١٠٨ أن نصيحة طبيب الأسنان عامل رئيسي يؤثر على خيار العلاج. كان لعمر الآباء تأثيرا لاختيار لفلورايد الفضة ثنائي الامين كخيار للعلاج (بمعنى آخر الذين أعمارهم ٣١-٤٠ عاما كانوا على علم أكثر بعلاج فلورايد الفضة ثنائي الامين بالمقارنة بالذين أعمارهم أقل أو أكبر).

الاستنتاجات: وجدنا أن قبول الوالدين لفلورايد الفضة ثنائي الامين بالمقارنة لعلاجات تسوس الأسنان الأخرى لدى الأطفال كانت عالية عند تزويدهم بخيارات علاجية أكثر تدخلا. يعتبر المظهر الجمالي وتكلفة العلاج ذو أهمية للآباء.

الكلمات المفتاحية: تجميل؛ الأطفال؛ تسوس الأسنان؛ فهم الوالدين؛ فلورايد الفضة ثنائي الامين

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Abstract

Objectives: This study aims to identify and extract parental perception and acceptance of silver diamine fluoride (SDF) application in treating dental caries with the objective of a) evaluating parental acceptability of SDF as a treatment choice for dental caries in their children and b) investigating parental concerns regarding the use of SDF for childhood caries.

Methods: A cross-sectional survey using a reliable questionnaire was conducted among parents of children aged 2-10 years, who reported to the department of paediatric dentistry at two dental hospitals between June 2020 and January 2021.

Results: 197 participants/guardians were included in the study and 128 showed acceptability towards SDF, out of which, 99 preferred upper posterior teeth for the treatment. The dentists' advice became a major factor affecting treatment option for 108 participants. Parental age also impacted the choice of SDF as a treatment option (i.e., those aged 31-40 years were more aware of SDF treatment than younger or older age groups).

Conclusion: Parental acceptance of SDF in comparison to other dental caries treatment options in children was found to be higher when more invasive treatment choices were provided. Aesthetic appearance and cost of treatment were significant concerns for the parents.

Keywords: Aesthetic; Children; Dental caries; Parental perception; Silver diamine fluoride

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Introduction

Dental Caries is a global issue that is exponentially increasing at an alarming rate. According to the recent statistics by Kassebaum et al.,¹ 60–90% of preschool and school going children across the world, that is, over 621 million children, are affected. Restoring teeth affected by caries may not always be achievable because of affordability and limited access to dental services, especially in low-income settings such as Pakistan. Furthermore, traditional restorative caries management for incredibly young children is challenging, and sometimes advanced pharmacological management, such as general anaesthesia and sedation is needed.²

Silver diamine fluoride (SDF) is a safe modern-day innovative material with proven anticariogenic properties, especially for young pre-cooperative children, including those with special healthcare needs. With its evidence-based safety, feasibility of application, and cost-efficacy, SDF may completely transform the community and paediatric dentistry.³ The disadvantage of this material is that it can stain the teeth black. The advantages of preventing caries with minimal distress to the child outweigh its disadvantages, particularly when access to dental care is constrained.⁴ SDF treatment offers stabilising effects on caries. Following a successful stabilisation phase and incorporating heightened preventive regimes focused on dietary control and strict oral hygiene practices can halt the progression of caries.^{2,5} Applying 38% of SDF solution twice a year has shown a caries arrest rate of 84.8%.⁶ A formulation of 38% SDF with potassium iodide (KI), which is applied as a separate reagent, is the combination that is currently in use. The application of KI after SDF, exhibited a reduction in the degree of black stains caused by the adverse effect of using SDF alone.⁷

According to latest evidence, SDF at a concentration of 38% is highly recommended by the American Dental Association (ADA) and American Academy of Pediatric Dentistry (AAPD) as a preventive measure to focus on comprehensive management plans to treat active cavitated lesions in young pre-cooperative children and individuals with medical complexities.⁶ It is well established in literature that parents showed statistically significant aesthetic tolerability for the application of SDF in posterior teeth as compared to the anterior dentition.^{3,8} Moreover, a study by Zhi et al. depicted that the easy and pain-free application of SDF compared to the conventional drill-and-fill approach was considered advantageous by parents.⁹ This implies that lack of knowledge could be another barrier in the acceptability of SDF. Parental acceptability of SDF treatment was higher when they were offered more information about this minimally invasive treatment modality and were allowed to make more informed choices. The literature supports a significant relationship between parental acceptance of SDF

and child cooperation; based on a report by Bagher et al.,¹⁰ parental acceptance is higher when their child is uncooperative. In a scenario where the child was cooperative and treatment was possible under local anaesthesia, only 27% chose SDF for treating the anterior dentition and 54% showed willingness for posterior teeth; however, if the child required general anaesthesia for oral rehabilitation, the preference for SDF treatment increased to 69% for posterior teeth and 60% for anterior teeth.¹¹ A practitioner is more likely to recommend SDF as a treatment option for posterior teeth than anterior dentition, particularly as an alternative to administration of general anaesthesia, which might gain acceptance from caregivers owing to its greater safety, convenience, and cost-effectiveness.^{4,12}

The aim of this study was to garner parental perception and acceptance of SDF as a minimally invasive treatment option, especially in non-cooperative paediatric patients. This study is novel in its attempt to understand the acceptability of this relatively recent dental material, known as SDF, as an alternative to complex and costly treatment modalities which may otherwise involve loss of tooth structure or the administration of conscious sedation or general anaesthesia.

Materials and Methods

This survey-based cross-sectional study was conducted among parents/caregivers of children with caries at the paediatric dentistry department of two university-affiliated dental teaching hospitals in Pakistan. A universal non-probability sampling technique was employed to recruit parents visiting the Outpatient Department between June and December 2020 for the treatment of dental caries of their children.

Considering the prevalence of dental caries among children aged 2-10 years in Pakistan, the sample size was calculated using the OpenEpi calculator which determined the number to be 197 with a 95% level of confidence, 90% study power, and 10% attrition rate.¹³

Inclusion criteria entailed parents capable of reading and understanding the English language and having children aged 2-12 years. The participants were verbally guided to fill out the questionnaire, following which written consent was obtained.

A 9-item questionnaire formulated by the partial adoption and modification of a study by Alshammari et al. was used as a data collection instrument.¹⁴ It was composed of five close-ended questions enquiring the knowledge and acceptance of parents regarding SDF by showing pictures of SDF-treated cases. The questionnaire was first piloted among 30 participants to ascertain its suitability. Face validity was established after the questionnaire was reviewed by two subject specialists, whose positive feedback suggested that no further changes were required. Items pertaining to demographics were included to assess the knowledge and acceptability of SDF in relation to a parent's/caregiver's monthly household income, level of education, gender, and geographical residence.

Complete consent was sought from the parents and confidentiality was ensured by keeping the responses

anonymous and any question that indicated participants' identity was excluded from the questionnaire.

Data analysis

The data were analysed using SPSS (version 23.0, IBM Corp., Armonk, NY, USA) data management software. Descriptive statistics for categorical variables were presented as frequencies. The chi-square test was used to compare the groups to find an association between dependent variables (knowledge of SDF treatment, parent acceptance of SDF treatment) and independent variables, including parents' gender, age, education, economic status, and area of residence. Statistical significance was set at $p \leq 0.05$.

Results

197 parents participated in this study, out of which the majority participants ($n = 101$, 51.3%) were female, and participants in the age group of 31-40 years were higher in number ($n = 125$, 63.5%). The educational status of most of the participants was good; 47.2% were graduates. Almost half of the participants (48.7%) had monthly incomes ranging from 31,000 to 50,000 rupees per month, and the majority of the participants (86.3%) belonged to urban areas. The demographic characteristics of the participants are summarised in Table 1.

Parents were asked about the number of times they took their child to the dentist, and many parents (44.2%) reported two dental visits per year. The most common procedure performed was filling (45.3%). Moreover, 82 (41.4%) parents reported that children did not cooperate during dental

procedures. The majority of parents (54.8%) declared that the preference of dentist affected the choice of treatment for their child. Table 2 summarizes the information regarding dental treatments, as reported by the parents.

Only 24.4% of parents knew about SDF. An overwhelming majority (65.0%) said that SDF treatment was acceptable to them. It was found that 48.2% of parents were concerned about aesthetics after SDF treatment. Compared to the other treatment modalities, SDF treatment was preferred by 20.3% of the parents as shown in Table 3.

It was found that parents in the middle-aged group (31-40 years) were more likely to know about SDF treatment compared to younger (20-30 years) and older age groups (41-50 years) (50% vs. 25% vs. 25%, respectively, $p = 0.001$). Similarly, parents with high economic status (>50,000

Table 1: Summary of demographic characteristics of the study group (n = 197).

Sr. no.	Characteristics	n (%)
1.	Age of child in years (mean \pm SD)	6.25 \pm 1.96
2.	Relation to the child	
	• Mother	101 (51.3%)
	• Father	96 (48.7%)
3.	Gender of child	
	• Male	86 (43.7%)
	• Female	111 (56.3%)
4.	Age group of parent (years)	
	• 20-30	51 (25.9%)
	• 31-40	125 (63.5%)
	• 41-50	21 (10.7%)
5.	Level of education	
	• Illiterate	3 (1.5%)
	• Primary	3 (1.5%)
	• High school	39 (19.8%)
	• Graduate	93 (47.2%)
	• Postgraduate	59 (29.9%)
6.	Monthly income (Rupees/month)	
	• 11,000-30,000	12 (6.1%)
	• 31,000-50,000	96 (48.7%)
	• >50,000	89 (45.2%)
7.	Area	
	• Urban	170 (86.3%)
	• Rural	27 (13.7%)

Table 2: Information regarding dental treatments as reported by parents (n = 197).

Dental Treatment Responses	n (%)
How many times has your child been to a dental clinic?	
• Once	53 (26.9%)
• Twice	87 (44.2%)
• More than twice	30 (15.2%)
• Never	27 (13.7%)
Treatment carried out when you took your child to a dental clinic	
• Filling	83 (48.8%)
• Root canal	24 (14.1%)
• Extraction	36 (21.1%)
• Orthodontic treatment	24 (14.1%)
• Dental checkup only	3 (1.9%)
Was your child cooperative during previous dental treatment?	
• Yes	88 (44.7%)
• No	82 (41.6%)
• Never been through a dental procedure	27 (13.7%)
Factor is most likely to affect choice of treatment for your child	
• Cost	36 (18.3%)
• Dentist's advice	108 (54.8%)
• Esthetics	12 (6.1%)
• Longevity	41 (20.8%)
Do you know about silver diamine fluoride (SDF)?	
• Yes	48 (24.4%)
• No	149 (75.6%)
Acceptability of SDF treatment, if performed on your child	
• Acceptable	128 (65.0%)
• Neutral	45 (22.8%)
• Not acceptable	24 (12.2%)
Which teeth would you consider getting this treatment done on?	
• Upper anterior	21 (10.7%)
• Upper posterior	99 (50.3%)
• Lower anterior	6 (3.0%)
• Lower posterior	47 (23.9%)
• None	24 (12.2%)
Concerns associated with SDF treatment	
• Aesthetics	95 (48.2%)
• Cost	69 (35.0%)
• Repeated appointment	12 (6.1%)
• Potential effect on permanent teeth	21 (10.7%)
Which treatment would you prefer over SDF?	
• Filling	58 (29.4%)
• Extraction	18 (9.1%)
• None	16 (8.1%)
• SDF will be first preference	40 (20.3%)

Table 3: Relationship of parental demographic characteristics with knowledge of SDF treatment.

Parent characteristics	Knowledge of SDF treatment		p-value
	Yes (n = 48)	No (n = 149)	
Gender			
• Female	24 (50.0%)	77 (51.7%)	0.840
• Male	24 (50.0%)	72 (48.3%)	
Age Group (years)			
• 20–30	12 (25.0%)	39 (26.2%)	0.001*
• 31–40	24 (50.0%)	101 (67.8%)	
• 41–50	12 (25.0%)	9 (6.0%)	
Education			
• <12 years	9 (18.8%)	36 (24.2%)	0.437
• >12 years	39 (81.3%)	113 (75.8%)	
Monthly Income			
• <30,000	0 (0%)	12 (8.1%)	0.008*
• 31–50,000	18 (37.5%)	78 (52.3%)	
• >50,000	30 (62.5%)	59 (39.6%)	
Residence			
• Rural	3 (6.3%)	24 (16.1%)	0.084
• Urban	45 (93.8%)	125 (83.9%)	

*Significant p-values.

rupees/month) were more likely to know about SDF treatment than parents with middle (31,000-50,000 rupees/month) and low (11,000-30,000 rupees/month) economic status (62.5% vs. 37.5% vs. 0%, respectively, $p = 0.008$). However, educational status and parental gender had no significant association with knowledge of SDF treatment. The association between knowledge of SDF treatment and parental demographic characteristics is shown in [Table 3](#).

Detailed analysis of the acceptability of SDF treatment revealed that a significantly higher number of parents with strong economic status accepted SDF treatment compared

to middle- and lower-income groups (53.1% vs. 37.5% vs. 9.40%, respectively, $p < 0.001$). Similarly, parents from urban areas were more likely to accept SDF treatment than parents from rural areas (81.3% vs. 18.8%, $p = 0.015$). The association between the acceptance of SDF treatment and parental demographic characteristics is shown in [Table 4](#).

Discussion

Despite being preventable, untreated childhood caries is currently a leading chronic dental disease with significant impact on development, function, and quality of life in growing children.¹⁵ With nearly 530 million children affected by dental caries each year, the problem presents as a "silent epidemic".¹⁶ Therefore, an in-depth exploration to tackle the growing burden of childhood dental caries is indispensable.

Lower socioeconomic strata of underdeveloped countries with high levels of unmet oral health care essentials emphasizes the need for cost effective and less invasive treatment options that cater to the needs of the masses. SDF application is one of the minimally invasive treatment modalities for carious teeth in children. Although international studies have been published on SDF acceptance, there is a scarcity of literature on parental acceptance of SDF treatment in this part of the world, with a vacuum for further studies. Considering that SDF acceptance and its utilisation in Pakistan is still primitive, this survey concentrated on establishing data by measuring responses and assessing the general acceptance of parents towards SDF treatment in relation to aesthetics.

Despite the higher number of female participants in this study, men were more receptive to SDF. This can be associated with the better exposure of males than females; out of 149 participants who showed no knowledge of SDF, 77 were women and 72 were men. The remaining 48 participants who were knowledgeable with at least 12 years of education and belonged to the high income class, showed significant

Table 4: Relationship between parental demographic characteristics and acceptance of SDF treatment.

Parent characteristics	Acceptability of SDF treatment			p-value
	Acceptable (n = 128)	Neutral (n = 45)	Not acceptable (n = 24)	
Gender				
• Female	59 (46.1%)	27 (60.0%)	15 (62.5%)	0.138
• Male	69 (53.9%)	18 (40.0%)	9 (37.5%)	
Age Group (years)				
• 20–30	36 (28.1%)	12 (26.7%)	3 (12.5%)	0.463
• 31–40	77 (60.2%)	30 (66.7%)	18 (75.0%)	
• 41–50	15 (11.7%)	3 (6.7%)	3 (12.5%)	
Education				
• <12 years	33 (25.8%)	6 (13.3%)	6 (25%)	0.223
• >12 years	95 (74.2%)	39 (86.7%)	18 (75%)	
Monthly Income				
• <30,000	12 (9.4%)	0 (0%)	0 (0%)	<0.001*
• 31–50,000	48 (37.5%)	30 (66.7%)	18 (75.0%)	
• >50,000	68 (53.1%)	15 (33.3%)	6 (25.0%)	
Residence				
• Rural	24 (18.8%)	3 (6.7%)	0 (0%)	0.015*
• Urban	104 (81.3%)	42 (93.3%)	24 (100%)	

*Significant p-values.

acceptance levels. Therefore, it was established that the level of education strongly affected the knowledge and acceptability of this treatment. Therefore, a preoperative session with parents, providing them knowledge about SDF can effectively lead to its acceptance. This is in agreement with a study by Sabbagh et al. (2020) according to which parents were more accepting of SDF treatment when scientific literature regarding SDF, evidence-based benefits of this treatment, and methods of application were clearly explained and discussed with them.³

Middle-aged participants were more aware of SDF treatment than others. This can be attributed to the higher participation of middle-aged people (63.5%) compared to younger and older participants in this survey. Owing to better awareness about SDF, its acceptability was found to be higher in the middle-aged group (31-40 years) which is not in agreement with a previous study conducted in the Middle East by Alshammari et al.¹⁴

The current study found a significant association between parental acceptance and household income. This agrees with previous literature where Asif and Gurunathan reported similar results with an association between parental income and acceptance of SDF in India,¹⁷ Pakistan's neighbour, with comparable socioeconomic environment and social classes.

The monthly income of guardians was divided into three groups in the questionnaire to assess if cost affects the choice of treatment option in underdeveloped countries. The results showed that acceptability of SDF was higher in the high-income group (53.1%). This acceptability decreased to 37.5% in the average-income group and then to 9.4% in the low-income group, which clearly indicates that the cost of treatment is also a major concern for parents ($p < 0.001$). However, compared to other factors concerning SDF treatment, aesthetics weighed more (48.2%) than the cost-effectiveness (35.0%). In this study, 48.2% of the participants expressed serious apprehension about aesthetics. The literature establishes that changes in dental appearance are noticeable to almost all people regardless of their profession.¹⁸ Even laymen grade dentofacial aesthetics more than professionals.^{19,20} Aesthetics is an undeniable fact which proved to be a major concern for parents when opting for SDF treatment, followed by cost of treatment; therefore, the preference for posterior teeth being treated with SDF is higher. Statistical analysis showed that most parents who took part in this survey accepted SDF treatment for their children's posterior teeth. These findings are not in agreement with a recent study in which parents refused SDF treatment, even for posterior teeth.¹³ This shows flexibility of participants in the current population for emerging treatment and aesthetic concerns as being the major setback in this aesthetic-driven society. However, a recent study by Crystal et al. reported that 67.5% of participants from diverse backgrounds showed acceptance of staining on posterior teeth, but only 29.7% of parents considered SDF staining aesthetically tolerable to the anterior dentition ($p < 0.001$). These findings support the fact that most parents prefer SDF over advanced pharmacological behavioural management techniques, such as sedation and general anaesthesia.²¹

According to a recent study on the utilisation of SDF on children's primary and permanent teeth by Bagher et al.,¹⁰ SDF is considered an acceptable treatment for uncooperative patients, primary dentition, and posterior teeth. This shows

that aesthetics has a high rating from the parent's point of view. This agrees with the current study that rated aesthetics as an important concern for parents when opting for SDF treatment. The second major apprehension explicated by parents was the cost of treatment. However, when parents were given the choice of decision, the majority of participants (54.8%) considered dentist's advice as the most likely factor to affect treatment. Therefore, detailed discussions with dentists and brief knowledge about the enormous benefits of SDF, significantly increases the level of acceptance. The next factor affecting the choice of treatment was longevity as per the results from 20.8% participants. This was followed by cost factors and aesthetic concerns. However, as evident from literature as well as the findings of this study, parents', despite aesthetic concerns, prefer SDF treatment as a conservative technique over general anaesthesia particularly if the child is uncooperative.^{17,21}

Urban residents were found to be more accepting of SDF treatment, with a significance level of 0.015. This trend can be attributed to better knowledge/awareness, household income differences, and other social variables influencing parental perception and acceptability. The comparison of knowledge in these classes was insignificant, but the comparison of acceptability among participants belonging to these areas was found to be significant. As 75.6% of the total participants did not know about SDF, many (33.0%) preferred fillings over SDF for the treatment of their child and 18.3% opted SDF as the first choice of treatment.

Among those who visited dentist for their child, 48.8% went for filling purpose, which shows a higher frequency of caries in children. This provides a potential direction for the necessity of SDF in terms of the number of cases and its benefits compared to conventional restoration. Furthermore, maximum number of parents reported the cooperative behaviour of their child during the last dental treatment; proving that SDF therapy can be effectively performed.

One of the limitations of this study was that it was restrained to a specific geographic area (Pakistan), and lengthy interviews with parents were not conducted, as some part of the data was collected through a digital survey. Since this was among the initial attempts to explore the perception of SDF as a minimally invasive treatment option for the control and prevention of dental caries in Pakistan, a better understanding of variables influencing perception and utilisation had to be established. For this purpose, detailed interviews, focus group discussions, and/or post-treatment evaluations with all stakeholders (i.e. parents, children, dentists, and the pharmaceutical industry) are to be conducted. Due to a dearth of databases, absence of a centralised data pool, and the diverse ethnic and cultural background of Pakistan's population, the researchers of this study decided to proceed with a descriptive cross-sectional survey to analyse the current situation regarding SDF perception and utilisation. SDF is a minimally invasive treatment modality for caries reduction with virtually no side effects and has been globally accepted for efficient control and prevention of dental caries in high-risk, uncooperative, and special needs individuals, thus improving the quality of dental care. In many parts of the world, this material is still new and needs to be further explored for better dental care and control of dental caries. There is room for further research to assess the factors that influence parental acceptability.

Conclusion

This study concluded that SDF treatment was judiciously acceptable to most of the participants, some younger and older parents did not know about SDF, some showed a neutral response, and few were reluctant to go for this treatment. The majority of parents preferred fillings over SDF treatment. A higher number of parents with strong financial backgrounds were more accepting of SDF treatment in comparison to the middle-and low-earning groups. Acceptability of participants from urban areas was higher than those from rural areas. A detailed discussion regarding the advantages of SDF can increase its current acceptability among parents, especially when their child is not cooperative with conventional restoration and also they intend to avoid treatment under general anaesthesia.

Future recommendations include a proper interview with parents before performing any dental procedure on their child and recording their responses. Factors influencing the acceptance of SDF by parents have significant potential for assessment, which can be considered as a future direction for research.

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Conflict of interest

The authors have no conflict of interest to declare.

Ethical approval

This study was approved by the Research Committee of University College of Medicine and Dentistry, Lahore (Certificate no. UCD/ERCA/20/04g) and ensured ethical conduct of the study got issued in 2021. Informed consent was obtained from the participants after the research objective and aim, voluntary participation, right to autonomy and confidentiality, and the right to withdraw from participation in the study were explained to them.

Authors contributions

MW conceived and designed the study, conducted the research, provided research materials, and collected and organised the data. BA and SA drafted the manuscript. KT analysed and interpreted the data. BA and ZK provided logistic support and collected the data. The authors are involved in writing and finalising the draft of this article. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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