

Parental perception and acceptance of silver diamine fluoride treatment among Syrian refugees

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Objective: Silver diamine fluoride (SDF) is an effective cariostatic agent, although staining associated with treatment is a significant impediment to its acceptability. **Basic Research Design:** A cross-sectional study of Syrian refugees to identify acceptance of SDF treatment. **Methods:** Information was collected on: sociodemographics, medical/dental child history, dental status (dmft/DMFT), and perceptions of photographs of SDF-treated teeth. Associations between clinical findings and the acceptability were assessed. **Results:** Of 258 parents or guardians, 37.8% accepted SDF treatment for their children. Acceptance was related to the location and type of teeth, being higher for primary than permanent teeth, and posterior than anterior teeth in both dentitions. Uncooperative behavior during previous dental treatment, the presence of dental discoloration, history of child dental pain, and number of filled teeth were all associated with better parental acceptance. Acceptance was also related to parental age, level of education, and their relation to the child. **Conclusion:** Parents' acceptance of SDF treatment is low. However, staining on posterior teeth was more acceptable than staining on anterior teeth and on primary more than permanent teeth.

Keywords: Oral health, caries, refugees, Silver diamine fluoride, cariostatic

Introduction

Caries is one of the most prevalent chronic diseases, affecting 60-90% of children worldwide (Petersen, 2003). Caries in children results in acute and chronic infections leading to pain, discomfort, and eating and sleep disruption. Caries can also negatively affect child growth and development (Sheiham, 2005).

Contemporary understanding of caries pathology has shifted management away from the concept of complete mechanical caries removal to less invasive methods focusing on controlling the biofilm activity, based on selective carious tissue removal or no tissue removal at all (Schwendicke, 2017). One treatment approach that does not require caries removal is the application of silver diamine fluoride (SDF) (Chu *et al.*, 2002), an inexpensive topical agent that is easy to apply to carious lesions (AAPD, 2018). Many studies have supported its efficacy in arresting caries (Chu *et al.*, 2002; Clemens *et al.*, 2017), and there are no reports of toxicity or adverse events related to its use (AAPD, 2018). A recent evidence-based guideline published by the American Dental Association (ADA), recommended SDF as a promising non-restorative treatment to arrest caries in primary and permanent teeth (Slayton *et al.*, 2018). In addition, its ease of use offers advantages for some patients with special needs (AAPD, 2018), including those who are very old (Shanahan and O'Neill, 2017), and for use in areas without a strong infrastructure, such as rural or indigenous areas (Lopez and Andrade, 2011).

The main drawback of the use of SDF is that it can cause dark, permanent staining of treated dentine (AAPD,

2018). A survey of directors of pediatric residency programs in the United States found that the most frequently reported barrier to its use was the preconception that parents would not accept the treatment as they may be concerned about the aesthetics of treated teeth (Nelson *et al.*, 2016). However, parental acceptance of SDF treatment has been shown (Kumar *et al.*, 2019, Huebner *et al.*, 2020). Acceptance has been related to having children who are very young, uncooperative, require advanced behavioral techniques, and wanting to avoid treatment under sedation or general anesthesia. Location of the staining may also be a factor (Crystal *et al.*, 2017; Bagher *et al.*, 2019).

The Syrian crisis began in 2011 and has displaced Syrians and more than 5.5 million refugees in the region (UNHCR, 2020). According to UNHCR, there are nearly 660,000 Syrian refugees in Jordan, of whom almost 125,000 (18.9%) live in camps (UNHCR, 2020). Children comprise a high proportion of the camp populations, with 42% under the age of 12 (UNHCR, 2020). Of the three main refugee camps in Jordan, Zaatari camp, located close to the Syrian border in Northern Jordan, is the largest with nearly 77,000 refugee residents, nearly 40% of whom are under 12 years old (UNHCR, 2020).

The camps are overcrowded, and conditions for the refugee children result in them being vulnerable to many health problems (Salim *et al.*, 2021b) including risk of poor oral and dental health. Combined with limited access to dental services, these oral health challenges negatively impact their oral health-related quality of life (Salim *et al.*, 2020a, b; Salim and Tiwari, 2021). Dental treatment for refugee children using traditional methods is costly, and resources in refugee camps are limited. Advanced

behavior management techniques, including treatment under general anesthesia and sedation, are neither affordable nor accessible (Salim *et al.*, 2020a; b).

Considering all these barriers and challenges, the use of less expensive non-restorative treatments such as SDF could be of great benefit. No previously published studies have assessed SDF acceptability among refugees. The objectives of this study were: 1) to determine parents' (or guardians) acceptance of SDF treatment among refugees in Zaatari camp and identify factors that may influence its acceptability, and 2) to investigate the association between parents' acceptance of SDF treatment and the dental status of their children. The null hypothesis was that there was no association between dental status and parental acceptance of treatment.

Materials and Methods

This study was approved by the Ethical Committee of the School of Dentistry of the University of Jordan (75/2020/71) and in full accordance with the World Medical Declaration of Helsinki. Written informed consent was obtained from each parent (or guardian) before clinical examination of their children.

This cross-sectional study was conducted at dental clinics at the Zaatari refugee camp between Aug 2019 and Nov 2019. The study population to address the primary objective comprised a convenience sample of adults who were parents or guardians attending dental clinics. As the outcomes related to refugee opinion regarding SDF, all parents (irrespective of whether their child was receiving care at that time) were invited to take part in face-to-face interviews. To address the secondary objective, children accompanying their parents at the time of the study underwent a dental examination in addition to the parental interview.

The target population was parents of children aged two to twelve years old in Zaatari camp, to include children in the primary and mixed dentition stages. Children of this age represent around 40% ($n = 31,000$) of the camp's total population (UNHCR, 2020).

The sample size was calculated in relation to the first objective using Naing *et al.* (2006): $n = Z^2 P (1-P) / d^2$. Where n = sample size, $Z = 1.44$ (level of confidence 85%), $P = 0.5$. and $d = 0.05$ (precision). As there were no data on the acceptability of SDF in the target population we followed the standard convention of using a conservative value for P (the expected proportion in population) of 0.5. Thus, a sample of 206 was needed. However, we aimed for a larger sample to allow for any exclusions whilst maintaining power.

Data for the first objective were collected from parents in face-to-face interviews with closed responses. The interview guide was based on a literature review of interviews to assess parental acceptance of SDF using photographs taken before and after treatment (Crystal *et al.*, 2017; Bagher *et al.*, 2019). The validity of the questionnaire was assessed by five general dentists experienced in questionnaire studies volunteering at the camp. Pilot testing with parents at the dental clinics assessed each question for clarity. The interviews were conducted by one dentist and another dentist conducted the clinical examination to eliminate bias.

The first part of the questionnaire enquired about sociodemographic data, including the parent's relation to the child (father, mother, or other), the parent's age, educational level, socioeconomic level according to family income, and the child's age, gender and medical history. The second part enquired about the child's dental history; previous dental pain, previous behavior when receiving dental treatment, the aim of treatment as seen by parents, how many times the child brushed his/her teeth, and the presence of any discoloration on the child's teeth. The child's previous behavior was considered uncooperative if the child had a history of crying or kicking while receiving treatment, needed a long time to complete the procedure, or if treatment was modified or withheld because of their behavior.

The interviewer then described SDF treatment to each participant as a material to stop caries that can be easily painted onto carious teeth without any side effects, except the permanent staining. The information highlighted that the dark color indicated that SDF was doing its work in stopping caries. Then, printed color photographs were shown to the parent presenting examples of carious teeth before and after SDF treatment for both anterior and posterior teeth. The participants were then asked to score the acceptability of the treatment for anterior and posterior teeth for primary teeth then for permanent teeth, on 5-point scales (5: strongly acceptable, 4: acceptable, 3: neutral, 2: not acceptable, and 1: strongly not acceptable). Participants were asked if their opinion would differ if the child was a girl or a boy.

For the second objective, child patients who were accompanied by their parents were clinically examined for caries according to the WHO (1997) criteria. The examiner was trained and calibrated for intra-examiner reliability. The results showed excellent agreement with a kappa value of 0.90. For each child, the numbers of of decayed, missing, and filled teeth were calculated for both primary/permanent teeth (dmft/DMFT) and the presence of discoloration was recorded as generalized if more than three teeth were discolored.

Statistical analysis was performed using SPSS for Windows release 16.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were generated for all variables. The normality of the SDF acceptance scores was tested by measuring skewness, kurtosis, z values, and the Shapiro-Wilk test. Chi-square test, independent sample t -test, ANOVA test, Bonferroni Post Hoc test, and Spearman's rank correlation test were used to examine associations between the independent variables of the parents and children and the acceptability of SDF treatment scores. The significance level was $P < 0.05$.

Results

Between August and November 2019, 258 parents or guardians participated to express their general acceptance of SDF (Table 1). Half the participants were mothers, and almost half were aged 31-40 years. Family monthly income was less than or equal to 200 Jordanian Dinars (JD). The vast majority of their children had a history of dental pain, had sought treatment for pain, and either did not brush their teeth at all or brushed infrequently.

Table 1. Characteristics of 258 parents and guardians and acceptance of SDF treatment.

Variable		Caregiver acceptance of SDF								
		%	Anterior 1° teeth		Posterior 1° teeth		Anterior 2° teeth		Posterior 2° teeth	
			Mean ± SD	p	Mean ± SD	p	Mean ± SD	p	Mean ± SD	p
Relation to child	Father	31.8	3.00± 1.29	0.029	3.32 ± 1.32	0.055	2.17 ± 1.11	0.040	2.84 ± 1.29	0.362
	Mother	50.4	2.85± 1.42		3.64 ± 1.15		1.8 ± 1.14		3.08 ± 1.32	
	Guardian	7.4	2.11± 1.15		3.11 ± 0.94		2.00 ± 1.2		3.05 ± 0.78	
Parent age (y)	20-30	31.8	2.52± 1.26	0.049	3.20 ± 1.20	0.079	1.99 ± 1.10	0.769	2.74 ± 1.25	0.104
	31-40	46.5	2.98± 1.39		3.54 ± 1.20		1.96 ± 1.14		2.99 ± 1.28	
	41-50	18.6	3.02± 1.39		3.73 ± 1.23		1.92 ± 1.22		3.31 ± 1.27	
	>50	3.1	3.38± 1.30		3.50 ± 1.31		2.38 ± 1.30		3.12 ± 1.36	
Family income (JD)	No income	29.8	2.91± 1.45	0.342	3.69± 1.23	0.119	1.84± 1.11	0.493	3.12± 1.32	0.080
	≤ 200	56.6	2.90± 1.29		3.40± 1.20		2.03± 1.14		3.01± 1.22	
	>200	13.6	2.54± 1.44		3.23± 1.24		2.00± 1.24		2.54± 1.36	
Parent education	Mid school	54.3	2.93± 1.39	0.517	3.68± 1.20	0.009	1.82± 1.12	0.062	3.09± 1.34	0.253
	High school	27.1	2.70± 1.22		3.20± 1.09		2.19± 1.11		2.89± 1.14	
	University	18.6	2.88± 1.48		3.23± 1.36		2.10± 1.14		2.77± 1.28	
Child's age (y)	2-4	15.5	2.42± 1.36	0.057	3.42± 1.32	0.909	1.92± 1.05	0.549	2.82± 1.34	0.694
	5-7	40.7	3.03± 1.27		3.50± 1.18		2.07± 1.19		2.98± 1.26	
	8-12	43.8	2.85± 1.42		3.44± 1.23		1.90± 1.13		3.03± 1.29	
Child's gender	Male	51.6	3.02 ± 1.31	0.054	3.53 ± 1.17	0.351	2.07 ± 1.17	0.169	2.98 ± 1.29	0.915
	Female	48.4	2.69 ± 1.39		3.39 ± 1.28		1.87 ± 1.11		2.97 ± 1.28	
Child medical history	Fit	96.9	2.86 ± 1.37	0.822	3.47 ± 1.23	0.832	1.98± 1.14	0.806	2.97± 1.29	0.540
	Not fit	3.1	2.75 ± 1.28		3.38 ± 1.06		1.88± 1.36		3.25± 0.71	
Child's history of pain	Yes	79.8	2.93± 1.35	0.076	3.55± 1.18	0.020	1.92± 1.13	0.121	3.06± 1.26	0.041
	No	20.2	2.56± 1.38		3.12± 1.34		2.19± 1.17		2.65± 1.30	
Cooperation during previous treatment	Cooperative	48.1	2.93± 1.38	0.764	3.49± 1.25	0.260	1.90± 1.13	0.048	2.92± 1.30	0.695
	Uncooperative	19.4	2.90± 1.34		3.52± 1.22		2.08± 1.16		3.16± 1.25	
	Do not know	6.2	2.75± 1.00		2.88± 0.89		2.69± 0.95		3.06± 0.93	
	No visits	26.4	2.72± 1.42		3.51± 1.23		1.87± 1.16		2.93± 1.33	
Treatment goal	Cosmetic	5.4	2.93± 1.64	0.979	3.43± 1.45	0.707	2.07± 1.33	0.472	2.79± 1.48	0.154
	Pain	79.5	2.85± 1.33		3.44± 1.23		2.00± 1.15		3.05± 1.23	
	both	15.1	2.85± 1.44		3.62± 1.07		1.77± 1.04		2.64± 1.41	
Presence of discoloration	Yes	66.3	2.99 ± 1.33	0.029	3.70± 1.09	<0.001	1.87± 1.11	0.034	3.13± 1.26	0.007
	No	33.7	2.60± 1.38		3.00± 1.33		2.18± 1.19		2.68± 1.27	
Tooth brushing frequency	1/day	22.5	3.03± 1.49	0.176	3.72± 1.04	0.111	1.98± 1.37	0.085	3.24± 1.33	0.291
	2/day	7.8	2.45± 1.05		3.05± 1.10		1.95± 1.05		2.80± 1.06	
	3≥/day	1.6	2.25± 1.50		2.50± 1.73		1.25± 0.50		2.25± 1.50	
	Not daily	42.2	2.72± 1.37		3.46± 1.28		1.82± 0.99		2.98± 1.24	
	Never	26.0	3.07± 1.28		3.43± 1.23		2.27± 1.16		2.84± 1.33	

JD: Jordanian Dinars

Greater acceptance of SDF treatment for anterior teeth was associated with the participant being a father, of older age or the child already having tooth discoloration (Table 1). Acceptance for posterior primary teeth was associated with lower parental education, child history of dental pain and the presence of dental discoloration.

Acceptance for anterior permanent teeth was greater among fathers, among parents whose children had not cooperated during previous dental treatment or with existing dental discoloration. SDF for posterior permanent teeth was accepted more often when the child had a history of dental pain or existing dental discoloration.

Parental or guardians' acceptance of SDF treatment (i.e. those scoring 5 or 4) varied for different types of teeth. Overall, 37.8% were accepting of SDF treatment compared to 40.1% who were not. Acceptance for primary teeth (42.3%) was greater than for permanent teeth (28.3%) and for posterior (49%) than for anterior teeth (25.2%) (both $p < 0.001$).

The overall mean of acceptance score of SDF treatment was 2.82 ± 1.36 . Mean scores for primary teeth and permanent teeth were 3.16 ± 1.33 and 2.47 ± 1.31 respectively ($p < 0.001$). Mean scores for anterior and posterior teeth were 2.41 ± 1.33 and 3.22 ± 1.27 respectively ($p < 0.001$). Acceptance of SDF treatment was greater for posterior primary teeth (mean score = 3.47 ± 1.22), than posterior permanent teeth (2.98 ± 1.28) or anterior primary teeth (2.86 ± 1.36), and lowest for anterior permanent teeth (1.97 ± 1.14) ($p < 0.001$). Acceptance was lower for anterior than posterior primary teeth ($p < 0.001$) and for anterior than posterior permanent teeth ($p < 0.001$).

Mean dmft/DMFT among the 110 clinically examined children was 5.93 ± 3.61 . Missing or filled teeth comprised a small proportion of this total (mean mt/MT = 0.45 ± 0.96 . Mean ft/FT = 0.22 ± 0.61). However, acceptance of SDF was higher among parents whose children already had filled teeth ($p = 0.047$).

Discussion

The application of SDF as a low-cost antimicrobial and remineralizing agent to arrest carious lesions holds promise for the challenging conditions and limited access to dental treatment in refugee camps. This study measured parental acceptability of SDF treatment to be used for their children. To our knowledge, this is the first study to assess parental acceptability of SDF treatment among refugees.

Parental acceptance of the SDF treatment was low among these refugees. This low level of acceptance is a consistent finding (Bagher *et al.*, 2019; Kumar *et al.*, 2019) that appears to be due to the staining caused by the material (Crystal *et al.*, 2017). Parents have rated aesthetics as the most important consideration for restorative materials used in their children's treatment (Zimmerman *et al.*, 2009). Interestingly, one study reported that the staining from SDF treatment did not influence parent acceptance (Belotti *et al.*, 2016).

Parental acceptability was related to the location and type of teeth being treated. This is consistent with other studies where treatment with SDF was more acceptable for posterior teeth (Crystal *et al.*, 2017; Bagher *et al.*, 2019) and is compatible with the emphasis placed on appearance

(Zimmerman *et al.*, 2009), also seen with parental preference for tooth-colored restorations over amalgam fillings or silver metal crowns (Holan *et al.*, 2009; Pani *et al.*, 2016; Holsinger *et al.*, 2016). Greater acceptance of SDF treatment for primary than permanent teeth has also been reported (Bagher *et al.*, 2019), and may be explained by the eventual exfoliation of primary teeth.

The finding that existing dental discoloration was associated with higher acceptance of SDF treatment is novel to this study. Existing compromised aesthetics may make the side effect of SDF staining less relevant than the benefits of treatment. This is compatible with the finding that a history of dental pain and higher dmft/DMFT were also associated with higher acceptance of SDF treatment for posterior primary and permanent teeth. Interestingly, fathers were more likely to accept SDF treatment for anterior primary and permanent teeth, which may be related to men placing less emphasis on aesthetics than women (Armalaite *et al.*, 2018).

In line with our findings, parental acceptance of SDF has been shown to be higher among parents of uncooperative children or those who required advanced behavior management (Crystal *et al.*, 2017; Bagher *et al.*, 2019). Parents may be willing to compromise aesthetics in favor of less invasive care if their child's cooperation is a barrier for traditional treatment. A similar finding was reported by Clemens *et al.* (2017), who reported parental acceptance of SDF treatment in anterior teeth to avoid the possibility of their child having sedation or general anaesthesia.

Acceptance of SDF treatment for posterior primary teeth was higher in less educated parents and higher (but not significantly so) in low-income families. Acceptance of a less aesthetic treatment among people of lower income and educational level has been reported previously (Holan *et al.*, 2009), especially in relation to SDF (Crystal *et al.*, 2017). This may be explained by the greater importance given to aesthetics and health by parents of higher socioeconomic status (Magno *et al.*, 2019). The slight inconsistencies between our findings and other studies may relate to the low income among our participants. Mean monthly income for refugees inside camps is very low (167 JDs per month) and compares poorly to refugees living outside the camps (250 JDs) and the national average for Jordanians (1,610 JDs) (UNHCR, 2019; Salaryexplorer.com, 2021).

Whilst the acceptability of SDF treatment was low among these refugees, the children had high levels of untreated dental disease (Mean dft/DFT = 5.26). There is therefore a need for cost efficient treatment, and thus efforts should be made to increase the awareness and acceptability of parents for treatment with SDF.

As is the case with all research, these findings should be viewed with caution. Children's behavior during dental treatment was assessed in parents' reports. None of the participants had a child who had received SDF treatment. This lack of experience might have influenced their perception and preferences for treatment. Furthermore, the use of interviews conducted by a healthcare professional may have increased social desirability bias in responses. However, the study provides invaluable information on the dental health of child refugees and highlights the lack of awareness of less invasive cariostatic

agents such as SDF. This information will serve the host country, humanitarian organizations and whoever might be involved in planning and development of oral health promotion interventions.

In conclusion, parental acceptance of SDF was low but was higher for primary and posterior teeth and for children with previous dental conditions and uncooperative behavior during treatment. Oral health disparities remain a major concern for this population; professionals should offer SDF treatment to patients and their parents and increase the awareness of this treatment option.

Conflict of interests

The Authors declare no conflicts of interest.

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