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To cite this article: J Caroline *et al* 2018 *J. Phys.: Conf. Ser.* **1073** 042001

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Effect and impact of silver diamine fluoride application in primary teeth caries on children's quality of life

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Abstract. Caries is the greatest oral health problem in children aged 3–5 years in Indonesia. Early caries treatment can heal toothache and increase quality of life. Silver diamine fluoride (SDF) is used to treat primary teeth caries. Herein, we evaluated the quality of life of 59 children aged 3–5 years 3 months after SDF application. Mothers were given a quality of life questionnaire before and after application. After SDF application, 89.36% of caries were arrested and the quality of life of the children had significantly increased ($p < 0.05$). SDF was effective in treating primary teeth caries and increasing children's quality of life.

1. Introduction

Caries is a relatively significant health problem in Indonesia. Data from the Indonesia Basic Health Research (Riskesdas) in 2007 stated that the national decay-missing-filled teeth (DMFT) index was 4.85 [1]. According to the Indonesian health minister in 2005, tooth and oral disease was ranked 1 of 10 among the most frequent disease complaints in Indonesian people; 62.4% of citizens admitted that their work/study activity was disturbed by tooth pain for an average of 3.86 days per year [2].

Caries prevalence in toddlers was reported to be high; according to a survey from the Faculty of Dentistry Hassanudin University in Malili, 70% of toddlers in Malili had dental caries [3]. A high caries prevalence in toddlers also was found in Tasikmalaya city. In 2012, in a kindergarten in Tasikmalaya city, Hermawati showed that 77% of students (aged 3–5 years) had a high degree of caries ($\text{def-t} > 2.7$) [4]. Meanwhile, in 2012 in Serpong, South Tangerang, Maharani showed an average DMFT of 5.45 in children aged 3–5 years [5]. Therefore, toddlers, particularly those aged 3–5 years, are considered to be highly susceptible to the development of dental caries.

The most frequent symptoms of dental caries are pain and an uncomfortable sensation around the teeth and in the oral cavity. Thus, caries is significantly related to quality of life [6]. Severe caries may affect children's growth and development due to reduced food intake caused by loss of appetite. Growth also may be inhibited in cases of caries with pulp inflammation and abscess because the caries spreads to the pulp and disturbs the body metabolism. Treating the caries may initiate proper growth and increase the quality of life in children [7].

Some effective ways to treat enamel and dentin caries in primary teeth include glass ionomer cement restoration, pit and fissure sealant [8], topical fluoride [9], and silver diamine fluoride (SDF), which has



been widely applied in Australia, Japan, and Brazil [10]. SDF can reduce tooth demineralization caused by caries and can inhibit the growth of cariogenic multispecies biofilms [11].

SDF has been proven effective in inhibiting dentin and enamel caries and can be used to treat primary teeth caries in children, particularly less cooperative children. SDF application is an easy, cost-effective, and simple procedure that directly inhibits and prevents the development of caries [10]. Its application in primary teeth caries directly arrests caries, thereby allowing children with prior difficulties in chewing, eating, or performing activities to be productive again and increasing their quality of life.

According to the Indonesia Basic Health Research in 2007, data on the required treatment index showed that 23.4% (58.5 million) of people in Indonesia have tooth and oral problems and require immediate treatment, but only 29.6% (17.3 million) had been treated compared to 6.9% (17.25 million) of children in the 1–4-year age group. In the 5–9-year age group, 21.6% (54 million) children had tooth and oral problems, but only 30.9% (16.69 million) had been treated. The treatment rate for dental caries (extraction, restoration, and tooth surgery) was 38.5%. Therefore, we studied the use of SDF to fulfill the need for early caries treatment in the community [1].

SDF has been used as an alternative dental caries treatment for primary teeth in some countries such as Brazil, Argentina, and Japan. A study has shown that SDF was effective in treating primary teeth caries [10]. In Indonesia, studies on SDF have been performed but only in small groups [12].

In June 2012, SDF was applied in 11 toddlers in Kaka Tua Posyandu (Integrated Service Station), Cimanggis, Depok, who were subsequently evaluated in September 2012, October 2012, and June 2013. The results of June 2013 showed an absence of secondary caries in the cavity treated with SDF. However, some children developed new caries lesions in different teeth. The absence of caries in treated teeth proved the efficacy of SDF treatment for primary teeth caries. People in the local community stated that SDF application was beneficial in arresting caries and preventing tooth pain, and they did not consider the black color effect from SDF to be a problem [12].

Further large-scale studies on SDF application in Indonesia are required. To the best of our knowledge, no study has evaluated the effect of SDF treatment on children's quality of life. Therefore, the present study aimed to determine the effect of SDF application on the quality of life of Indonesian children with primary teeth caries.

2. Methods

This experimental study was conducted with a parallel control group design on children aged 3–6 years in Rama-rama Kindergarten, Serpong, Indonesia. Subjects were divided into treatment (children with active dentin caries who agreed SDF application) and control (children agreed to be examined but refused SDF application) groups. The mothers were well informed about SDF treatment for caries in children, benefits and disadvantages of SDF, how SDF works, and the application procedure. Then, the mothers were asked to fill out an informed consent and an Early Childhood Oral Health Impact Scale (ECOHIS) questionnaire that had been modified into the simplified Indonesia language (modified-ECOHIS). The modified-ECOHIS questionnaire comprised questions on the effect of primary teeth caries on the quality of life of their children as well as family.

After tooth examination, all subjects were given a new toothbrush and tooth dental health education (DHE). Subjects that met inclusion criteria were called back, and SDF was applied. After application, subjects were asked not to eat, drink, or rinse the mouth for 1 h and to brush their teeth twice a day in the morning and at night. Control subjects were not given any treatment and were only asked to brush their teeth twice a day.

All subjects were reevaluated at 3 months after SDF application, and the mothers filled out another modified-ECOHIS questionnaire regarding the effect of primary teeth caries on the quality of life of their children and family. Data on active and arrested caries and the initial and 3-month modified-ECOHIS questionnaires were calculated and compared.

Data on decayed-extracted-filled teeth (DEFT) and surface (DEFS) indices between the treatment and control groups were analyzed with the Mann–Whitney *U* test, and the caries arrested percentage was determined in both groups. The early and 3-month modified-ECOHIS scores in both groups were

analyzed with the Wilcoxon test. The level of statistical significance was set at $P = 0.05$, and the 95% confidence interval was set at $\alpha = 0.05$.

3. Results

The average rate of arrested caries was 89.36% at 3 months after SDF application (Table 1). There was no significant difference in active caries between the two groups before application, but a significant difference was noted after 3 months. Caries that were already arrested (not active caries) at the beginning were not included in the percentage of arrested caries after treatment.

Table 1. Total arrested caries at 3 months after SDF application

Groups	Average Active Caries (SD)				% Arrested caries
	Before	P value*	After	P value*	
Treatment	10.53 (7.17)	0.393	9.41 (7.97)	0.000†	89.36
Control	8.88 (5.07)		1.38 (2.64)		15.54

*Using Mann–Whitney U test.

† $P < 0.05$ indicates significant difference.

Table 2 shows the result of the modified-ECOHIS score. P values with the Wilcoxon test showed significant results in the total score for the treatment group before and at 3 months after SDF application, whereas no significant difference was noted in the control group. The modified-ECOHIS questionnaire included six questions evaluating the quality of life related to the subject's teeth and oral health (Table 3).

Table 2. Quality of life before and after SDF application

	Modified-ECOHIS score (before)	Modified-ECOHIS score (after)	p value*
Control group	10.35	10.85	0.117
Treatment group	10.07	11.63	0.000†

*Using Wilcoxon test.

† $P < 0.05$ indicates significant difference.

Table 3. Results of modified-ECOHIS questionnaire and its correlation with DEFT and DEFS

Questions	Proportion of respondents answering YES (%)	Correlation with DEFT	Correlation with DEFS
Does your child ever feel pain in teeth, mouth, or jaws because of tooth cavity?	38.80	0.000*	0.001*
Does your child ever have difficulty in eating because of tooth cavity?	30.60	0.000*	0.000*
Does your child ever have difficulty in sleeping because of tooth cavity?	22.40	0.000*	0.000*
Does your child ever feel upset or frustrated because of tooth cavity?	28.20	0.000*	0.000*

Table 3. *Continue*

Does the mother or other family members ever feel upset because of your child's tooth cavity?	22.40	0.002*	0.001*
Does the mother or other family members ever take a day off or take up working time because of your child's tooth cavity?	18.80	0.008*	0.016*

*P < 0.05 indicates significant difference.

4. Discussion

Our results showed a higher rate of arrested caries in the treatment group (89.36%) than in the control group (15.54%), proving that SDF application with DHE was more effective than DHE alone. These results were compatible with those of Chu (2012) who treated active dentin caries for 24 months with DHE and SDF (treatment group) and DHE alone (control group) and found a higher prevalence of active dentin caries after 24 months in the control group [13].

Our findings suggested that SDF application in toddlers with primary teeth caries increases their quality of life. This may be indicated from the increase in the total modified-ECOHID score in the treatment group after 3 months and the significant difference noted from the nonparametric Wilcoxon test ($P < 0.05$). This increase also was noted in the control group, but there was no significant difference after 3 months.

Although some of the active caries lesions became inactive in the treatment group, active caries lesions had still developed after SDF application. These caries lesions mostly occurred in the posterior teeth, as stated in a previous study, and SDF was more effective in arresting dentin caries of the upper anterior primary teeth [13]. Active caries lesions that form in the posterior teeth may be influenced by the anatomical morphology of these teeth. Posterior teeth have pits and fissures as well as deeper curves in comparison to anterior teeth, which may lead to more plaque retention in the posterior teeth. SDF application in the posterior teeth may be obstructed by plaque that still remained although the subjects had already brushed their teeth. Caries lesions may have become active again because the subjects might have eaten and drunk immediately after SDF application, although they had been reminded not to eat, drink, or rinse their mouth for 1 h after application.

The questions on the modified-ECOHIS questionnaire represented a disturbed quality of life because of dental caries problems. The Spearman test revealed a significant correlation between the scores of the modified-ECOHIS questionnaire and the subject's oral health status ($P < 0.05$), showing that subjects with poor oral health or severe caries may have a low quality of life because of tooth pain.

Our study had a few limitations. There were only 59 children in the treatment group and 26 in the control group. Thus, the efficacy of SDF application in primary teeth caries and its effect on children's quality of life were less apparent. SDF was only applied in children with dentin caries; thus, its effect on enamel and pulpal caries in primary teeth was also less apparent. This may have resulted in the recurrence of active caries although SDF had been applied and may affect the modified-ECOHIS questionnaire scores because enamel or pulpal caries lesions were still actively disturbing the children's quality of life.

Further large-scale studies on the effect of SDF application on the quality of life of children must be conducted to reinforce our results. SDF application must also be differentiated between enamel, dentin, and pulpal caries lesions, so that its effect on the quality of life in children may be more evident.

5. Conclusion

Our findings suggest that SDF application along with DHE for treating primary teeth caries is more effective in arresting caries than DHE alone. Additionally, SDF application in primary teeth caries may potentially increase the quality of life of these children.

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