

Commentary

Outreach Service Using Silver Diamine Fluoride to Arrest Early Childhood Caries



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ABSTRACT

Early childhood caries (ECC) is prevalent and affects more than half of 5-year-old children in Hong Kong. This study aims to report the development of an outreach dental service using silver diamine fluoride (SDF) to arrest ECC amongst kindergarten children in Hong Kong. A pilot outreach service was initiated in 2008 in 14 kindergartens. The pilot service provided screening to 1,749 3- to 5-year-old children. SDF was applied to 3,262 carious teeth of 786 children with parental consent. No significant complications were reported. The pilot service's success allowed the service to expand to 100 kindergartens in 2013. From 2010 to 2019, the service delivered 161,354 dental screenings and SDF therapy on 218,333 carious primary teeth in 53,821 children. ECC prevalence amongst the participating children declined from 43% in 2010 to 34% in 2019. A follow-up of 222 3-year-old children revealed that annual SDF therapy arrested 67% of ECC over 3 years. The children's participation rate and their parents' satisfaction rate with the service were greater than 90% each year. Moreover, the acceptance rate of SDF therapy to control ECC was 88%, although SDF stained carious lesions black. No adverse effects of SDF therapy were reported. A cross-sectional survey on a sample of 498 3- to 5-year-old children showed that 96% of the participating children had no dental fear or anxiety in this service, with encouragement and support from their peers and teachers. In 2019, the service was made available to all 1,024 kindergartens in Hong Kong. This kindergarten outreach dental service (Case Study HKU/04/003) was selected as an Impact Case Study in the thematic report "Health & Healthcare" by the Hong Kong University Grant Council (UGC). The UGC publishes thematic reports to give members of the public some concrete idea on what contributions academic research has brought to the society.

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Introduction

Oral health is an important part of general health. The World Health Organization states that oral health is integral to general health and a key indicator of overall health, well-being, and quality of life.¹ Early childhood caries (ECC) is dental caries in the primary teeth of children younger than 6. ECC causes pain and infection, and advanced caries will progress into the tooth pulp and dental abscesses.² If children's carious teeth remain untreated, the disease leads to tooth loss and compromised dentition, which affects growth, development, and general health.³ The local infection developed from ECC may spread and even threaten the child's life.

ECC in Hong Kong

ECC is prevalent amongst 282,000 children younger than 6 in Hong Kong. The government provides an integrated child health and development programme through the Maternal & Child Health Centres to enhance children's holistic (physical, cognitive, emotional, and social) health and well-being.⁴ The integrated programme's core components are parenting,

immunisation, health, and developmental surveillance. Most children attend kindergarten when they are 3 years old, and around 144,000 children were enrolled in kindergarten in September 2022.⁵ The earliest available Hong Kong survey in 1968 reported that the ECC prevalence amongst 5-year-old children was 84%.⁶ Figure 1 shows the trend of ECC amongst 5-year-old Hong Kong children from the available epidemiologic data. A 2019 survey showed that the untreated ECC prevalence amongst 5-year-old Hong Kong children was 57%.⁷ Approximately 6% of the 5-year-old children experienced dental abscesses, which were probably associated with untreated caries. It is concerning that these children are unable to access organised dental care, exacerbating the situation.

The oral health survey conducted by the Department of Health showed that only about one-quarter of the parents had brought their 5-year-old children to visit a dentist. Half of these parents had brought their child to visit a dentist to address symptoms such as toothache, suspected caries, and dental trauma. Approximately a quarter of the children had extensive ECC experience (decayed, missing, and filled teeth [dmft] > 3), and this group of children contributed more than 80% of all the teeth affected by dental caries. Additionally, the

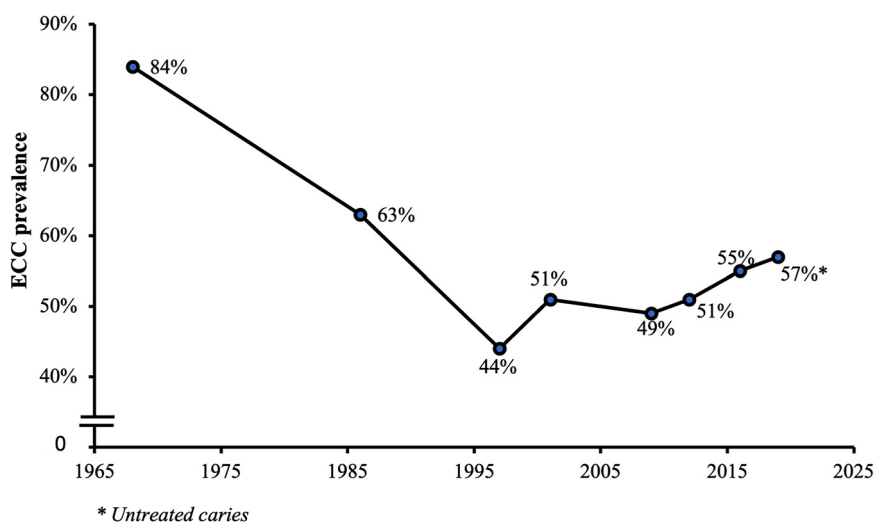


Fig. 1 – Early childhood caries prevalence amongst 5-year-old children in Hong Kong from 1968 to 2019.

phenomenon of oral health disparities amongst Hong Kong children based on various social demographics remains evident. In Hong Kong, parents, particularly those with low education levels, are unaware that ECC affects a child's general health, growth, and development; therefore, their children usually have a greater risk of experiencing dental caries.^{7–9} The disparity in ECC may be reduced by implementing an effective and appropriate oral health promotion policy.

Oral health promotion and education in Hong Kong

The Hong Kong government's policy on dental care is intended to raise public awareness of oral hygiene and encourage proper oral health habits through promotion and education.¹⁰ Oral health promotion can improve not only children's oral health but also their overall health and well-being. It has been conducted in many countries to reduce health disparities. In Japan, the success of oral health promotion has resulted in a marked reduction in ECC prevalence. Private dentists provide regular oral health examinations and preventive services tailored for children aged 18 months and older at local government health centres completely free of charge. Then, dental hygienists provide parents and their children with oral health education. In Hong Kong, the Department of Health provides highly subsidised dental treatment to primary school students aged 6 and older. It provides oral health education to young children younger than 5 years old through its Oral Health Education Division. Children with ECC only can seek dental care from private clinics.

Surveys have shown that ECC amongst Hong Kong kindergarten children is becoming serious amongst 3- (38%) to 5-year-old (55%) children.⁸ Unfortunately, conventional dental care for ECC management is not available, accessible, or affordable for this group of children. Although nearly all children in Hong Kong attend kindergartens, dental care is often unavailable, and accessibility to dental care is limited. Moreover, due to limited dental workforce resources, there is no organised dental care. Therefore, it is crucial to address this issue and provide accessible dental care to preschool students in Hong Kong to combat ECC effectively.

Silver diamine fluoride for ECC management

Silver diamine fluoride (SDF) is a liquid solution that contains silver ions and fluoride ions. Although the US Food and Drug Administration cleared SDF as an anti-hypersensitivity agent for use in adults older than 21 years old, clinicians often use SDF for arresting ECC in young children. SDF has been used for many years in Japan, and it is accepted as a therapeutic agent for dental treatment. SDF is available in concentrations of 3.8%, 12%, 30%, and 38% solution. Most of the commercially available SDF solution contain 38% SDF. A 38% SDF containing 255,000 ppm silver and 44,800 ppm fluoride ions. Silver is an antimicrobial and inhibits cariogenic biofilm. Fluoride inhibits demineralisation and promotes remineralisation of teeth. SDF is alkaline, which inhibits degradation of dentine collagen. Literature has reported that SDF arrests caries without affecting dental pulp or causing dental fluorosis. Additionally, SDF is an effective and safe method for managing ECC in children. Parents and caregivers should consult with their child's dentist to determine whether SDF is appropriate for a child's specific needs. SDF therapy is a noninvasive, painless, simple, and affordable tool for caries control. Our previous 30-month clinical trial showed that an annual application of 38% SDF effectively arrests dentin caries, and caries removal prior to SDF application was not necessary.¹¹ Apart from the known side effect of staining the carious lesion, the literature reports no significant complications associated with SDF therapy. Simple settings and reaching out to kindergartens can help provide children with accessible dental care in a familiar setting. This study showed the development of an outreach dental service using SDF to arrest ECC amongst 3- to 5-year-old kindergarten children in Hong Kong from 2010 to 2019.

Development of the outreach dental service

In Hong Kong, an outreach dental service was developed in 2008 with support from a government Health Care Promotion Fund (Seed Fund) for 1,749 children in 14 kindergartens. The objective of the service is to improve preschool children's

oral health by arresting their ECC.⁶ The service provided dental screening to identify cavitated carious lesions. With parental consent, dentists used SDF therapy to arrest the cavitated carious lesions.

Dental screening

A dentist and an assistant conducted the dental screening in a classroom or designated functional room in the kindergarten. The child was positioned supine on a table. Following the examination, the dentist provided parents with an individual dental report detailing the child's oral health status, ECC findings, and oral hygiene status. Significant oral findings included dental abscesses and significant tooth discolouration. The dentist would inform the parents, who could then choose to take their child to visit a dentist for consultation and care at their own expense.

SDF therapy

Children diagnosed with dental caries would receive SDF therapy at the kindergarten with parental consent. Before SDF application, the dentist removed food debris and plaque from the carious cavities with gauze. The dentist used gauze to isolate the child's decayed teeth and applied a 38% SDF solution on the carious tooth surfaces with a micro-applicator. An individual report on the child's oral health was provided to parents after SDF therapy. Parents were instructed to notify the outreach service dentist if their child experienced any pain or discomfort following the SDF application.

Participants of the outreach dental service

With the success of the pilot outreach kindergarten service in 14 kindergartens, the outreach service programme received community service funding. The outreach service expanded to serve 13,799 children from 50 kindergartens annually from 2010 to 2013, and it continued to expand with a matching fund to serve more than 24,404 children from 100 kindergartens annually from 2013 to 2016. The service was sustained

with 3 general research funds and industrial support from 2016 to 2019.

A total of 161,354 screenings were performed, and 38% (61,413/161,354) of them revealed ECC in children. Most parents (88%) allowed their children to receive SDF therapy on their child's carious lesions even after learning about the black staining it may cause. The service team provided 218,333 SDF applications to 53,821 kindergarten children.

Impacts of the outreach dental service

The outcomes to evaluate this outreach service are the ECC prevalence and caries arrest rate amongst the participating children. In addition, we used a closed-end questionnaire with a Likert scale to evaluate parents' satisfaction with the outreach service. In this outreach service, we also observed that many children could be examined successfully in kindergarten. We conducted a cross-sectional study to investigate the children's fear level during screening.

Decrease in ECC prevalence amongst the participating kindergartens

A major accomplishment of these 9-year projects is that they have caused a significant decline in the incidence of ECC amongst participating preschool students (Figure 2), from 43% (2010–2011) to 34% (2018–2019). This decline stands in obvious contrast to the lack of significant improvement observed in ECC prevalence in the whole of Hong Kong over the past 2 decades. The results of our 9-year follow-up demonstrated that our outreach kindergarten dental service project could arrest carious lesions in teeth and prevent sound teeth from developing ECC.

High caries arrest rate amongst the children receiving SDF therapy

In 2009, we performed a 30-month randomised clinical trial to follow up 222 3-year-old kindergarten children receiving

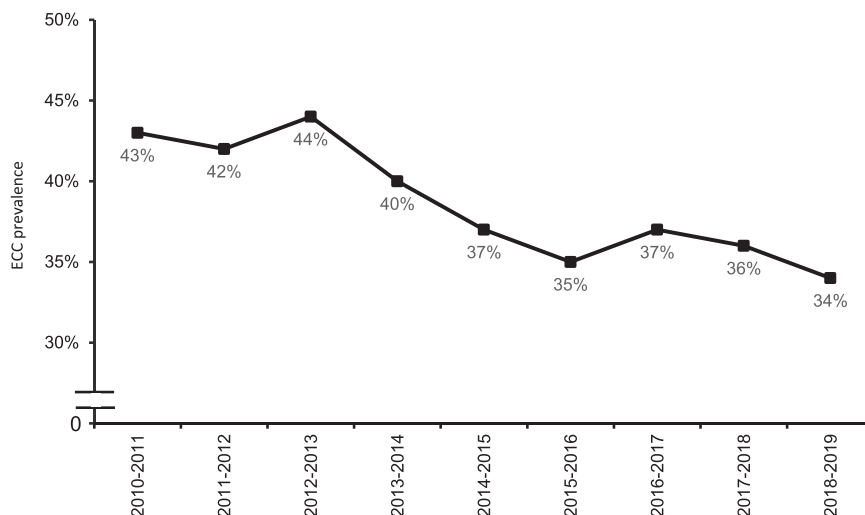


Fig. 2 – Prevalence of early childhood caries (%) amongst participating kindergartens in multiple service years.

annual SDF application.¹² We compared the caries arrest rate of these children with another 222 children receiving semiannual SDF application. Our clinical trial showed that annual 38% SDF therapy effectively arrested 67% of cases of ECC over a 3-year period.¹² Notably, the application of 38% SDF twice a year demonstrated more efficacy, effectively halting a remarkable 76% of cases ($P < .001$).¹² Annual SDF application takes a single visit to kindergarten per year, whereas semiannual application requires 2 visits per year. Semiannual SDF application is 43% $[(67\% - 76\%/2)/67\%]$ less cost-effective than annual SDF application because the service had inadequate resource which could not meet the need of the children.

Great majority of parents were satisfied with the outreach dental service

Questionnaire surveys were conducted to evaluate parents' satisfaction with the outreach service after 2013 except in 2014-2015. From 2013 to 2019, more than 90% of the parents were "satisfied" or "very satisfied" with the outreach service. A great majority of the parents replied that the outreach service was "helpful" or "very helpful" in improving children's oral health. Some parents commented that they hope the dentists could provide additional care for children with ECC, in particular emergency care for pain relief and infection.

Reduced dental fear and anxiety amongst children

Children who have never visited the dentist or who have only visited the dentist in pain are more likely to experience dental fear. We sampled 498 3- to 5-year-old children dovetailed to this long-term service for a study on dental fear and anxiety using the Frankl Behaviour Rating Scale. We found that dental fear and anxiety levels were only 4% amongst 3- to 4-year-old children attending the first or second year of kindergarten.¹³ No children had dental fear and anxiety when they were 5 years old and attending the third screening. Children who were mainly taken care of by their parents had a high level of positive and cooperative behaviour and a low level of dental fear and anxiety.¹³ Our findings are congruent with what previous studies have shown. The additional years of schooling helped children follow instructions and engage in the new experience of dental checkups and preventive fluoride treatment, and they improved the children's communication ability with the dentist and assistants.

Discussion

The outreach dental service targeted children with ECC for caries-arresting treatment using SDF therapy. We provided more than 160,000 dental screenings and applied SDF therapy on most of the children who had ECC with written parental consent. This simple, painless, and noninvasive care can arrest ECC and reduce the need for and hence the cost of complicated restorative treatment. Most parents preferred SDF therapy over conventional care, which is invasive and expensive. Some parents indicated that they would not take their child to visit a dentist due to the cost and time. Apart from the caries arrest rate after SDF therapy, we evaluated and found no

adverse effects of SDF therapy on more than 218,000 teeth over the span of 9 years.¹⁴ Blackening of carious lesions was common and associated with arrested lesions, suggesting that blackened lesions are an indication of success in arresting caries. Parents generally accepted their children having blackened carious lesions with an explanation and information before SDF therapy.¹⁵ Because of this outreach service's success, it has been expanded to all 180,000 kindergarten children in Hong Kong in 2019 with a charity fund's support.⁶ This kindergarten outreach dental service (Case Study HKU/04/003) was selected as an Impact Case Study in the thematic report "Health & Healthcare" by the Hong Kong University Grant Council (UGC). The UGC publishes thematic reports to give members of the public some concrete idea on what contributions academic research has brought to the society.

Summary

This study showed the development of an outreach dental service using SDF to arrest ECC amongst 3- to 5-year-old kindergarten children in Hong Kong. From 2010 to 2019, the service provided children more than 160,000 screenings, and few of them had dental fear or anxiety regarding the outreach service. The service provided SDF therapy on more than 218,000 carious teeth over 9 years with no report of adverse effects of SDF therapy. Most of the parents preferred this simple and noninvasive care over conventional restorative treatment, although SDF stained carious lesions black. The outreach service's success is reflected by the high caries arrest rate and extensive charity funding to expand the service to all Hong Kong kindergarten children. The Hong Kong University Grant Council has selected this service as an Impact Case Study in their thematic reports to give members of the public some concrete idea on what contributions academic research has brought to the society.

Conflict of interest

None disclosed.

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