A school-based fluoride mouth rinsing programme in Sarawak: a 3-year field study


Abstract – Background: This study was undertaken to assess the impact of fluoride mouth rinsing on caries experience in a cohort of schoolchildren 3 years after implementation. Methods: 270 children aged 8–9 years from four schools in Sarawak were selected at baseline. Baseline data was collected to ensure that the selected schools did not differ significantly. Children from two schools rinsed with 0.2% sodium fluoride under supervision, while those from the other schools did not. Results: After 3 years, 242 schoolchildren remained in the study. At the end of the study, the mean DMFT for the test group was 2.3 (95% CI, 1.93–2.67) while the mean DMFT for the control group was 4.01 (95% CI, 3.39–4.63). The mean DMFS for the test group was 3.40 (95% CI, 2.68–4.12) while the mean DMFS for the control group was 6.67 (95% CI, 5.47–7.87). After 3 years, 24.2% of those in the test group remained caries free compared to 11.5% in the control group. The risk of developing caries decreased 0.52 times among the children from the ‘test’ group exposed to the fluoride mouth rinsing programme as compared to the unexposed ‘control’ group (RR = 0.48, 95% CI, 0.26–0.85). Discussion and conclusion: The findings show that a school-based weekly 0.2% sodium fluoride mouth rinsing programme is an effective caries preventive measure and should be implemented in fluoride-deficient areas as a means of reducing the prevalence of dental caries in these communities.

Fluoride mouth rinsing is one of the most widely used caries preventive public health methods. In 1965, Torrel and Ericsson (1) reported that daily use of a 0.05% sodium fluoride mouth rinse reduced the development of new caries by 50%, while fortnightly rinsing reduced the caries level by about one-third. This study became a classic model in the field of fluoride mouth rinsing. The effect of fluoride mouthrinses on the incidence of caries in children has been extensively investigated during the past four decades in a large number of clinical trials. These have demonstrated the effectiveness of fluoride mouth rinses in reducing dental caries by 15–45% over a period of 2–6 years (2–5). A Cochrane review by Marinho et al. (6) concluded that regular and supervised use of fluoride mouthrinse by children is associated with a clear reduction in caries increment. The review found that daily and weekly or fortnightly rinse programmes resulted on average in 26% fewer decayed, missing or filled permanent tooth surfaces. It is thought that the caries-preventive effect of fluoride mouth rinsing relates to its influence on the demineralization/remineralization process in enamel and dentine (7).

Studies by Wei and Yiu (7) and Twetman et al. (8) have shown that school-based fluoride mouth rinsing programmes are a safe and effective means of controlling dental decay in children and adolescents, especially in communities with limited exposure to fluorides. In an evaluation of a supervised school-based fluoride mouth rinsing programme in Edinburgh, Levin et al. (9) concluded that fluoride mouth rinsing can be effectively targeted at children from deprived areas through school-based initiatives. In another evaluation on
preventive oral health activities for children in Woudenberg, The Netherlands, Pieterse et al. (10) concluded that children who had never rinsed with fluoride were almost four times more likely to have caries lesions than children who rinsed for at least 3 years. This strongly indicates that long-term rinsing with fluoride has a positive effect on caries status.

The findings of the National Oral Health Survey of School Children in Malaysia (11) showed that the oral health status of 12-year-olds in Sarawak was about 10 years behind that in Peninsula Malaysia. The mean DMFT (decayed, missing, filled teeth) of 12-year-olds in Peninsula Malaysia was 1.6 whereas in Sarawak it was 2.5. Following this, the Oral Health Division formulated a 10-year Master Plan, named Pinnacle 2010. The main objective of Pinnacle 2010 is to fast track the improvement in the oral health status of the people in Sarawak particularly schoolchildren. Key strategies towards the achievement of this objective include oral health promotion efforts such as oral health education, tooth brushing drills in primary schools as well as the expansion of community water fluoridation to more areas.

In Sarawak, only 69.5% of the population receives fluoridated water supplies (12). A fairly large population of schoolchildren, particularly those in the rural schools, do not receive the benefits of water fluoridation. Although the effectiveness of fluoride mouth rinses has been demonstrated in other localities, there have not been any similar studies in Sarawak. Thus, this study was undertaken to evaluate the effectiveness of a school-based weekly fluoride mouth rinsing programme among rural schoolchildren residing in a nonfluoridated area. This paper reports the impact of fluoride mouth rinsing on the caries experience of a cohort of schoolchildren from participating schools 3 years after implementation.

### Methodology

**Selection of the test and control schools**

Four schools in Selangau District, Sibu Division, were selected based on the following criteria: the schools were located in nonfluoridated areas with no public water supply. Their only source of drinking water was rain and river water with less than 0.1 ppm fluoride. The children were of similar socioeconomic and ethnic background (95.5% of the children were Ibans) and had high caries experience with a mean DMFT of 2.5 or higher at 12 years of age.

Prior to the start of the fluoride mouth rinsing programme, baseline data for all four participating schools was obtained to ensure that they were similar with regard to caries status, daily tooth brushing practices, use of fluoridated toothpaste and consumption of sweetened foods and drinks (Table 1). In order to verify whether students were using fluoridated toothpaste, students were interviewed and shown samples of popular toothpaste brands. These were classified into fluoridated and nonfluoride toothpaste based on available data (13–15).

The four selected primary schools were then assigned to ‘test’ and ‘control’ groups based on the school enrolment, accessibility and distance from the dental facility that would assist in supervising the fluoride mouth rinsing programme. As cooperation from school authorities and accessibility of participating schools were considered as critical to the sustainability of the field study, the selection of the ‘test’ schools was not randomized.

**Selection of the cohort**

Primary Two and Three (8 and 9-year old) schoolchildren formed the cohort for this intervention study. Parental consent for all participating schoolchildren, and approval from state and local

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**Table 1. Mean and mean difference in DMFT and DMFS scores at baseline and 3 years after implementation of fluoride mouth rinsing for the test and control groups (N = 242)**

<table>
<thead>
<tr>
<th>Study group</th>
<th>N</th>
<th>At baseline (95% CI)</th>
<th>After 3 years (95% CI)</th>
<th>Mean difference (95% CI)</th>
<th>SE mean</th>
<th>t (d.f.)</th>
<th>P-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean DMFT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test</td>
<td>120</td>
<td>1.06 (0.83–1.29)</td>
<td>2.30 (1.93–2.67)</td>
<td>1.24 (0.96–1.52)</td>
<td>0.14</td>
<td>8.84 (119)</td>
<td>0.00</td>
</tr>
<tr>
<td>Control</td>
<td>122</td>
<td>1.01 (0.79–1.23)</td>
<td>4.01 (3.39–4.63)</td>
<td>3.00 (2.47–3.53)</td>
<td>0.27</td>
<td>11.27 (121)</td>
<td>0.00</td>
</tr>
<tr>
<td>Mean DMFS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test</td>
<td>120</td>
<td>1.55 (1.04–2.06)</td>
<td>3.40 (2.68–4.12)</td>
<td>1.85 (1.33–2.37)</td>
<td>0.26</td>
<td>7.06 (119)</td>
<td>0.00</td>
</tr>
<tr>
<td>Control</td>
<td>122</td>
<td>1.49 (1.03–1.95)</td>
<td>6.67 (5.47–7.87)</td>
<td>5.18 (4.26–6.11)</td>
<td>0.47</td>
<td>11.08 (121)</td>
<td>0.00</td>
</tr>
</tbody>
</table>

*Paired *t*-test was performed.
education departments were obtained prior to the implementation of this study. Trial runs using plain water were conducted on two separate occasions prior to the actual rinsing with sodium fluoride solution. This was to ensure that all participating children were able to rinse correctly, and to avoid any possible ingestion of sodium fluoride solution. In this study, all participating children were able to rinse successfully after the trial runs.

**Procedure for fluoride mouth rinsing**

Following World Health Organization (WHO) recommendations (16), it was decided to adopt the once-a-week rinse regime, using a freshly prepared 0.2% sodium fluoride solution. Furthermore, there were less classroom interruptions with this method. School teachers were trained by the researchers to prepare and dispense the sodium fluoride solution. This was prepared by mixing a pack of 10 g of sodium fluoride in 5 l of distilled water. The mixture was shaken until all the sodium fluoride powder had dissolved. Ten millilitres of the freshly prepared sodium fluoride solution was dispensed to each child who then rinsed for 1 min under the teachers’ supervision once a week. The children were instructed not to eat, drink or rinse with water for the next 30 min. After two training sessions, the school teachers were able to prepare and dispense the sodium fluoride solution on their own. However, the researchers visited the schools weekly for a month, and then at 3-month intervals throughout the duration of the study.

**Examination for dental caries**

The participating schoolchildren were examined annually for dental caries by two dental public health officers. Caries was assessed using DMFT and DMFS indices, as described in WHO Basic Methods 4th edition, 1997 (17). Calibration for inter-examiner agreement was done at the beginning of the study on 20 subjects. The percentage agreement was 0.99 with a Kappa of 0.905.

**Data management and analysis**

Data was entered and analysed using SPSS Ver 12.0. The paired t-tests for mean and mean difference in DMFT and DMFS for the test and control groups were performed (18, 19). The assumptions made were that the test and control samples were independent, and variances were not equal. The McNemar tests for percentage caries free and the relative risk measure for the test group and control groups were also performed (19, 20). The significance level was set at \( P < 0.05 \).

**Results**

At baseline, 270 schoolchildren aged 8–9 years participated in the study. After 3 years, 242 schoolchildren were still in the programme. There were 122 children in the ‘control’ group and 120 from the ‘test’ group. The attrition rate was 10.3%, mainly due to transfers to other schools.

Prior to the start of the fluoride mouth rinsing programme, baseline data for all four participating schools was obtained to ensure that they were similar with regards to daily tooth brushing practices, use of fluoridated toothpaste and consumption of sweetened foods and drinks. No statistically significant differences between the test and control schools were found with regards to gender and daily tooth brushing practices. However, there was a slight difference in the amount of toothpaste used with 46.8% of children in the test group reporting that they used more than the recommended amount of toothpaste (pea-size amount) when brushing their teeth compared to 35.0% in the control group. There was also a slight difference in the amount of sweetened food and drinks consumed (with 29.4% of children in the test group reporting that they consumed sweetened food and drinks more than twice a day compared to 12.8% in the control group).

At baseline, there was no significant difference in caries status of the test and control groups. However, at the end of the study, there were significant differences in the mean DMFT and DMFS between the test and control groups. The mean DMFT for the test group was 2.30 [95% confidence interval (CI), 1.93–2.67, \( P < 0.00 \)] while the mean DMFT for the control group was 4.01 (95% CI, 3.39–4.63, \( P < 0.00 \)). The mean DMFS for the test group was 3.40 (95% CI, 2.68–4.12, \( P < 0.00 \)), while the mean DMFS for the control group was 6.67 (95% CI, 5.47–7.87, \( P < 0.00 \)) (Table 1). A higher proportion (24.2%) of the children in the ‘test’ group remained caries free at the end of the study compared to the ‘control’ group (11.5%). The McNemar test was significant (\( P < 0.00 \)). In addition, the risk of developing caries decreased 0.52 times among the children from the ‘test’ group exposed to the fluoride mouth rinsing programme as compared to the unexposed ‘control’ group (RR = 0.48, 95% CI, 0.26–0.85) (Table 2).
Discussion

The limitations of this study include those common to studies where assignment of subjects to test and control groups was known to the examiners. In this study, there was a difference in mean DMFT of almost two teeth between the test and control groups, and more children in the test group (24.2%) remained caries free compared to the control group (11.5%). This is similar to the findings of school-based weekly fluoride mouth rinsing programmes undertaken in Japan and Nepal (21, 22).

In a recent review on clinical findings regarding fluoride mouth rinses and implication for their use, Wei and Yiu (7) have recommended that school-based fluoride mouth rinsing programmes should be implemented in fluoride-deficient communities while Levin et al. (9) concluded that school-based fluoride rinsing was effective in lowering DMFT levels in areas of deprivation.

Studies by Ripa et al. (3), Kobayashi et al. (21), Holland et al. (23), Poulsen et al. (24) and others concluded that in order for more children to remain caries free throughout their school years, fluoride mouth rinsing programmes should start at a younger age, and be continued up to the age of 12–14 years, while Pieterse et al. (10) found that fluoride rinsing for at least 3 years has a positive effect on caries status. In Sarawak, children aged 7–12 years participated in weekly fluoride mouth rinsing, as these are the age groups that attend primary schools. Children younger than 7 years were not included in the programme, as there were concerns about accidental swallowing of the sodium fluoride solution among parents and teachers of the children. However, studies among Japanese preschool children have found that children aged 4–5 years can perform fluoride mouth rinsing safely and efficiently (25).

Although the cost of implementing a school-based weekly fluoride rinsing programme was not calculated in this study, a similar study in Japan (21) estimated the cost of implementation at US$ 0.20 per child per year.

In the WHO Country/Area Profile Programme, a review on a school-based fluoride mouth rinse programme for preschool children in Japan (26) concluded that this programme has so far been the only community oriented health measure that has contributed to caries prevention of the permanent teeth in areas where community water fluoridation is not available. The findings of the present study support this view.

In this study, no fissure sealant application was done as an additional caries preventive measure. However, in a 2-year study in Finland (27), the use of a combined fluoride rinsing and sealant programme in first permanent molars among 7- to 9-year-old children resulted in almost complete elimination of caries in the study group. In Ireland (28), a combined fortnightly 0.2% sodium fluoride mouth rinse programme was combined with sealants on the first and second molars in the test group, with impressive results. This suggests that a combination of fluoride mouth rinsing with fissure sealant applications would further enhance the impact of these caries prevention measures.

Conclusions and recommendations

The positive benefit of weekly sodium fluoride mouth rinses on caries reduction would be a major population-based strategy in our endeavour to ensure that schoolchildren remain caries free throughout their school years. Improvement in the oral health status of schoolchildren in Sarawak is one of the main objectives of the Pinnacle 2010 Master Plan. One of the impact goals in this Master Plan is to reduce the mean DMFT of 12-year-old schoolchildren to one or less by the year 2010. In the rural areas of Sarawak, where there is no fluoridated water supply and little access to oral healthcare services, it is even more important that schoolchildren remain caries free. Following the findings of this field study, weekly fluoride mouth rinsing was implemented in 18 rural primary schools throughout Sarawak.

Based on the findings of this study and other similar studies, we recommend that school-based weekly fluoride mouth rinsing programmes should be implemented in fluoride-deficient areas as a means of reducing the prevalence of dental caries in these areas. In addition, to get the maximum
impact of caries prevention, fluoride mouth rinsing programmes could be combined with other preventive activities such as fissure sealant application to further reduce caries levels.

Acknowledgements
The authors thank the Director General of Health, Malaysia, for permission to publish this study; Oral Health Division, Sabah Health Department, and the Sandakan District Oral Health Department for their cooperation and advice during the researchers’ visit to observe the fluoride mouth rinsing programme in Sandakan, Sabah; Divisional Dental Officer, Sibu, Sarawak, and the staff who assisted in the implementation and monitoring of the fluoride mouth rinsing programme; Sarawak Education Department and the Sibu Divisional Education Officer for permission to conduct this programme; and the principal, teachers and students of the participating schools in Selangau District, Sibu, Sarawak.

References