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Rosema NAM, van Palenstein Helderman WH, Van der Weijden GA. Gingivitis and plaque scores of 8- to 11-year-old Burmese children following participation in a 2-year school-based toothbrushing (SBTB) programme.

Gingivitis and plaque scores of 8- to 11-year-old Burmese children following participation in a 2-year school-based toothbrushing programme

Abstract: *Aim:* The present study assessed whether gingivitis and plaque scores of 8- to 11-year-old school children who participated in a SBTB programme for 2 years were lower than those of children who did not participate in the programme. *Material and methods:* The present study was performed using an examiner-blind, parallel group design and was performed in Burma (Myanmar) in 2006. Three of the five schools where daily SBTB programmes took place after lunch and which were performed under teacher supervision were randomly selected; three non-participating schools (non-SBTB) from the same area were assigned as controls. Twenty-five children per school were examined for gingivitis (bleeding on marginal probing) and plaque (Quigley & Hein). *Results:* In total, 150 8- to 11-year-old children participated, with 75 children in either group. The test group (SBTB) exhibited an overall mean bleeding score of 0.76. For the control group (non-SBTB), this score was 0.83. With respect to the overall mean plaque scores, the test group exhibited a score of 2.93, whereas the control group exhibited a score of 2.91. No statistically significant differences between the test and the control group were observed. *Conclusion:* The present study did not reveal a statistically significant effect of daily SBTB programmes in 8- to 11-year-old school children with respect to gingivitis and plaque scores.

Key words: dental plaque; gingivitis; manual toothbrush; school-based toothbrushing

Introduction

Major inequalities exist with respect to oral health between developing and industrialized countries (1). The prevalence and the risk of dental caries and periodontal disease follow social gradients, with much higher rates of morbidity observed in deprived communities (2). In 2008, the Commission on the Social Determinants of Health (CSDH) presented a conceptual framework that addressed poor diet, lack of hygiene and poor education as causes of poor health. Furthermore, the Commission placed these causes within a broader picture of 'causes of causes', which included economics and the unfair distribution of resources, poor policies and programmes, and poor governance (3).

Within this complex of social determinants, daily toothbrushing with fluoride toothpaste is likely the most important and cost-effective method

for improving oral health (4, 5). In its 2007 resolution, the World Health Organisation (WHO) urged its member states, among other recommendations, to develop and implement school health programmes (6). The school is a unique setting for developing a child's oral health-related habits given that such behaviours are formed at an early age (7–9). With respect to school health programmes, prevention has always been promoted by health education based on the idea that knowledge transfer concerning a healthy diet and regular toothbrushing would lead to behavioural changes; however, the available evidence indicates that such approaches have been completely ineffective (10, 11).

In Myanmar, specifically in rural areas, daily toothbrushing is not a common habit for the majority of people. Therefore, a skill-based pilot project was initiated with the collaboration of the local dentist. The present school-based toothbrushing (SBTB) programme was performed with the help of schoolteachers, and first graders participated in a daily SBTB with fluoride toothpaste. Few SBTB studies have addressed the possible impact on the gingival condition and on dental plaque accumulation in children (12–15). The present study aimed to test whether the gingivitis and plaque scores of 8- to 11-year-old school children who participated in a SBTB programme for 2 years were lower than those of school children who did not participate in this programme.

Material and methods

Study design

The present study was performed using an examiner-blind, parallel group design and was performed in the Taik-kye township, a semi-urban and rural area approximately 80 kilometres north of the former capital, Yangon, Burma (Myanmar) in 2006. Five schools took part in a 2-year project in the Taik-kye area, where daily SBTB programmes were performed under the teachers' supervision. Three of these five schools were selected for this investigation according to a randomization list. Three non-participating schools (non-SBTB) from the same area were assigned as controls.

The present SBTB programme was initiated and launched by a local dentist in collaboration with the schoolteachers of the project schools. The participating schools initiated the toothbrushing programme in 2004 with the aim of reducing the incidence of caries; the participant children in this programme were in the first grade (aged 6–9 years). Fluoride toothpaste and toothbrushes with nametags were provided and were stored at the schools. The teachers were instructed by the local dentist on how the brushing procedure should be performed. The children were instructed by the teachers regarding how to brush their teeth with short horizontal strokes (16) in a systematic way to clean all the surfaces of their dentition. The toothbrushing was always performed following lunch on weekdays and was accompanied by a popular Burmese children's song to ensure a consistent and sufficient duration of brushing. While this 'caries-driven' project was underway, it was suggested that the study population could also be assessed for gingivitis and plaque scores. At the time of the examination, the children had been on holiday for 2 months and had just returned to school. It was decided based on the available literature (12) to perform the assessment following the completion of the SBTB programme.

Subjects

For each of the participating schools, prior to the assessments, third graders were randomly recruited from the class and, starting with the 'front row seated' children, screened for eligibility criteria. Subsequently, the next row was screened. Only children with at least six permanent incisors and all four permanent first molars were enrolled in the study. Screenings were performed until 25 children met the inclusion criteria. Ethical approval for the study was obtained from the Institutional Ethical Committee of the Department of Medical Research, Lower Myanmar. Informed consent was given by the parents for the clinical assessment.

Products

The type of toothbrush used in this study was 'Kids' from Jacomo®, Thailand, which has the following specifications: 129 mm in length; eight rows of filaments; 25 tufts; 35 monofilaments per tuft; height of monofilaments, 10 mm; and diameter of filaments, 0.4 mm (Fig. 1). The provided dentifrice was 'Fresh-up', a locally manufactured standard sodium monofluorophosphate dentifrice containing 1000 ppm fluoride.

Clinical assessments

The gingival condition of the children was assessed using the bleeding on marginal probing (BOMP) index as described by Van der Weijden *et al.* (17). In this index, the absence or presence of bleeding is scored within 30 s of probing on a 3-point scale of 0 to 2 (0 = non-bleeding, 1 = point bleeding and 2 = excess bleeding). Subsequently, plaque was assessed using a modification of the Quigley & Hein (18) plaque index, as described by Paraskevas *et al.* (19). First, the plaque was disclosed using a new cotton swab using fresh disclosing solution (Mira-2-Ton®; Hager & Werken GmbH & Co. KG., Duisburg, Germany) for each quadrant. After disclosing, the subjects rinsed with water, and the plaque was assessed using a 6-point scale of 0 to 5 (0 = no plaque, 5 = plaque covering greater than two-thirds of the tooth surface). The levels of bleeding and plaque were assessed for all of the upper and lower 1st permanent molars, all of the permanent lateral and permanent central incisors, the deciduous 1st and 2nd molars, the deciduous cuspids, and when erupted, the permanent cuspids and permanent premolars. Each tooth was assessed for both indices at 6 surfaces: distal-vestibular, mid-vestibular, mesial-vestibular, distal-lingual, mid-lingual and mesial-lingual. All of the clinical assessments were performed by a single experienced examiner (N.A.M.R.) who was blind to the identity of the SBTB and

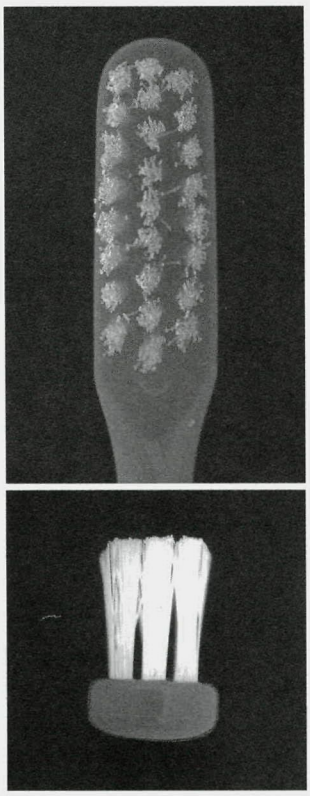

Fig. 1. Occlusal and frontal view of the 'Kids' toothbrush.

non-SBTB schools. As dental chairs were unavailable at the schools, a long classroom bench was used on which the children were placed in a supine position, with their heads on a pillow on the lap of the examiner. The assessments were performed with the help of compressed air and an intra-oral fibre optic light unit.

Statistical analyses

The primary response variables for this study were the gingivitis and plaque scores. The means of both indices were calculated for each subject at each school and subsequently analysed for significant differences between the test and control groups. The mean values for both parameters were also calculated in terms of their presence or absence. To allow for a more transparent interpretation of these analyses, both indices were transformed into a dichotomous index, whereby bleeding was considered as present for scores of 1 or 2. With respect to plaque, scores with at least a small band of plaque along the gingival margin (scores 2–5) were defined as the presence of plaque. Nonparametric tests were used to check for significant differences between the experimental and control groups and between the schools.

Because of the lack of data regarding the prestudy gingival condition of the examined group, a power calculation that was based on the plaque data from a toothbrush study in a similar population was used (20). As the observed mean plaque score in this previous study was approximately 2.5 (SD = 0.5), and 25 children per school were considered to be an appropriate and convenient sample size for this study, the minimum detectable difference was calculated to be 0.40, with alpha set at 0.05 and beta at 0.20. This detectable difference (0.40) exceeds the minimum difference of clinical relevance of 0.375, which is 15% of the mean PI, according to the ADA Acceptance Program Guideline – Toothbrushes. Therefore, this detectable difference value was considered appropriate (21).

Results

Data were obtained from each of the 150 children examined (25 per school). The children had a mean age of 8.9 (SD = 0.6) years (range, 8–11 years). The overall mean bleeding index (BI) for the test group (SBTB) was 0.76; this score was 0.83 for the control group (non-SBTB). Of the 150 subjects, none were free of bleeding, and only two subjects exhibited a BI percentage of <20%. Moreover, 90% of the total population exhibited a BI percentage >30%. With respect to the overall mean plaque scores, the test group scored 2.93, whereas the control group scored 2.91. The data regarding the percentage of sites with gingivitis (BOMP > 0) and the percentage of sites with plaque (Q&H > 1) are presented in Table 1. No statistically significant differences were observed between the test and control groups.

As many of the examined children exhibited mixed dentition, the data were also analysed separately for permanent teeth and deciduous teeth. This analysis demonstrated that the permanent teeth presented with lower bleeding scores compared to the deciduous teeth. The plaque scores were higher for the permanent teeth than for the deciduous teeth (Table 2).

The gingivitis and plaque scores are presented by school in Figs 2 and 3. Within the control group, significant differences were observed between schools with respect to the plaque scores (Kruskal–Wallis, $P < 0.001$).

Discussion

Little published information is available regarding the prevalence of gingivitis or periodontal disease in Burmese children. In fact, there is limited information regarding the dental situation of the Myanmar population in general. A 1983, WHO report on oral health in Myanmar states that the identified

Table 1. **Overall means and percentages for gingivitis and plaque for both test (SBTB) and control (non-SBTB)**

	Test $n = 75$	P^*	Control $N = 75$
Mean BOMP	0.76 (0.26)	**0.297**	0.83 (0.34)
% BOMP	51 (14)	**0.253**	55 (19)
Mean Q&H	2.93 (0.64)	**0.792**	2.91 (0.58)
% Q&H	87 (8)	**0.479**	85 (8)

BOMP, bleeding on marginal probing.
*P-value from Mann–Whitney test.
Bold values indicate significance.

Table 2. **The percentage of gingivitis and plaque for permanent and deciduous teeth for both test (SBTB) and control (non-SBTB) schools**

	Test				Control			
	Permanent	Deciduous	Difference	95% CI of difference	Permanent	Deciduous	Difference	95% CI of difference
BOMP	46*	57	11	8.9 <> 14.2	51*	59	8	5.3 <> 10.9
Q&H	90*	83	7	5.4 <> 9.7	88*	83	5	2.9 <> 7.3

BOMP, bleeding on marginal probing; SBTB, school-based toothbrushing.
*Statistically significantly different between deciduous and permanent teeth: $P < 0.001$ (Mann–Whitney test).

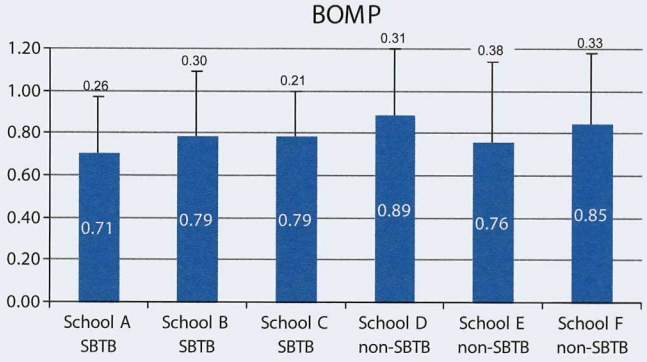

Fig. 2. Gingivitis scores per school.

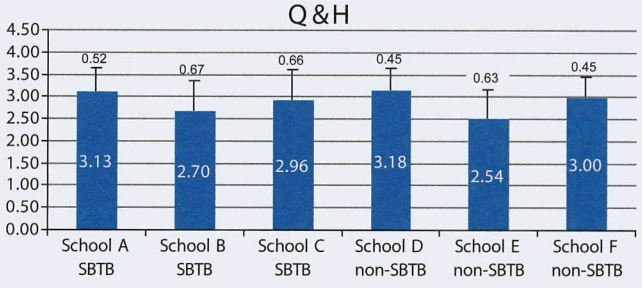

Fig. 3. Plaque scores per school.

problems to be solved are 'poor oral hygiene in children', 'severe gingivitis in children' and 'severe dental caries – especially in primary dentition' (22). Data regarding oral health in Myanmar were relatively recently published by Ogawa *et al.* and Soe *et al.* (23, 24). Both concluded that the knowledge, attitude and practices related to oral health were poor in Myanmar. Moreover, this previous study reported that among a group of 14-year-old students in an urban setting, caries had the most frequent impact on individuals' quality of life.

With regard to the gingival condition of the present population, the observed mean BI percentage was approximately 53%. It is difficult to compare these results to those of other studies given that no data on gingivitis rates are available for the Myanmar population. However, it is likely that the situation in Myanmar is similar to those of the neighbouring countries, Laos and Thailand. Although data from other countries cannot be directly extrapolated to Myanmar, studies regarding gingival health performed in these countries among primary school children report a prevalence of the clinical symptoms of gingivitis to be 88–99% (25–27). Comparing these data with the present study is difficult given that different indices were used. However, 90% of the present population exhibited a BI percentage >30%. Therefore, it can be concluded that the prevalence of gingivitis among primary school children in Myanmar is high and likely similar to the rates observed in other countries in the region.

The observed mean plaque scores of approximately 86% and the mean PI of approximately 2.9 illustrate the limited results of the toothbrushing programme in this population. This result is in accordance with those of a study by Van Palenstein *et al.* (20), where it was reported that children reduced their plaque scores by no more than 25% when asked to brush to their best ability without any time restriction in a single brushing episode. A contributing factor for the lack of an effect on plaque scores may be that the supervising teachers did not have had the skills required for giving effective toothbrushing instructions. Although the children under investigation brushed under teacher supervision, it is questionable whether the teachers were the most effective instructors given that they are not dental professionals. However, given the very limited dental workforce in the Taik-Kye region, the initiator of the project considered the teachers to be the best option to fulfil this task. Another explanation for the lack of an observed effect of the toothbrushing programme may be that giving toothbrushing instructions to a group may not be effective at significantly reducing plaque levels in a relatively young population. Because it is generally recognized that children up to the age of approximately 10 years are not effective at toothbrushing, international and national associations and paediatric dentistry foundations have guidelines on oral hygiene stating that parents should brush their children's teeth until the children reach approximately 10 years of age (28).

In the present study, in both the test and control groups, the gingival bleeding scores of the deciduous teeth were statistically significantly higher ($P < 0.05$) than those of the permanent teeth. Additionally, the plaque scores were significantly lower ($P < 0.05$). This unexpected finding cannot easily be explained; however, the effect of the exfoliation process of the deciduous teeth or immature status of the gingival complex of the permanent teeth and the consequence on both plaque accumulation and inflammatory responses may contribute to this observation (29). To examine the reason for this

observation, the data were examined separately for the vestibular and lingual aspects of the teeth and for the frontal and dorsal position of the teeth in the dental arches. The data were also separately analysed at the site level, and the same observations were made. The observed difference between the permanent and deciduous teeth is in contrast to the observations of Ramberg *et al.* (30). In their study, *de novo* plaque formation was analysed following a week's abstention from oral hygiene. The related gingivitis development was also investigated among children with a mixed dentition. The development of gingivitis was found to be similar for both the deciduous and permanent teeth. However, these data cannot easily be compared to those of the present study given that de novo plaque formation differs from established plaque; moreover, a 1-week abstinence from oral hygiene may be too short of a period to evaluate its effects on gingivitis (31).

The present analyses also revealed that the lateral incisor consistently exhibited higher plaque scores (mean score, 3.23) than the neighbouring central incisor (2.73). A possible explanation for this 0.5-point difference may be linked to the plaque-scoring method. The Quigley & Hein (18) plaque index assesses plaque by means of coverage of the tooth surface. As the observed mean overall plaque score was close to 3, indicating 'plaque coverage of more than 1 mm but not more than one-third of the tooth surface', the exposed tooth surface has a great impact on the actual score. This implies that a tooth that is not fully erupted receives a higher score for the same amount of plaque compared to a fully erupted tooth. The fact that the permanent central incisor is further erupted at the age of the investigated group than the lateral incisor may explain the present observation.

The previously reported positive results for interventions are often obtained during or at the end of a project and should not be directly compared with the present study, which performed the analyses 3 months following the termination of a project. In a paper by Horowitz *et al.*, (12) the 2-year follow-up results of a daily SBTB programme among 10- to 13-year-old children were reported. In this previous study, the plaque and gingivitis scores of the test group exhibited significant differences at 20 months when compared to those scores of children in non-SBTB participating schools. However, the results following 24 months were collected following the summer holiday and indicated that this significant difference had virtually disappeared. It was suggested that the children in the treatment group did not pursue the oral hygiene practices that had been taught at school to any appreciable extent during the summer break. The outcome of the present study indicates that assessing the possible beneficial effect of a SBTB programme may require that the data be collected some time after the project is discontinued. Indeed, in the present study, no positive effect was observed following the summer holiday. These previous findings and the present observations agree with the conclusion drawn in a report by Van Palenstein Helderman *et al.* (13), where the effects of weekly supervised SBTB did not result in statistically significant reductions in plaque or gingival bleeding scores. The authors ascribed the lack of an effect on plaque and bleeding scores to the absence of support at home to practise what they had learned at school during the remainder of the week.

The present SBTB programme was initiated by a local dentist, but the local community (parents of the schoolchildren, educational authorities, local leaders, etc.) was unfortunately not involved in this undertaking. Consequently, this SBTB programme did not fulfil the five guiding principles of the Ottawa Charter for health promotion: (i) promoting health through public policy, (ii) creating a supportive environment, (iii) developing personal skills, (iv) strengthening community action and (v) reorienting health services. The core element of any public health approach is the empowerment of local communities to become actively involved in efforts to improve (oral) health. This aspect was missing in the present school health programme (32).

In conclusion, the present investigation did not demonstrate significantly lower gingivitis and plaque scores in children from schools participating in a 2-year SBTB programme when compared to children from non-SBTB schools when the results were measured 3 months following the termination of the programme. These results may call into question the usefulness of such school programmes. Alternatively, the literature indicates that daily SBTB with fluoride toothpaste in deprived communities is of great value in reducing the caries incidence, justifying the implementation of such programmes given that caries is a widespread dental disease (14, 33–35).

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Conflict of interest and source of funding

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