Long-Term Effect of an Oral Health Promotion Program for Schoolchildren after the Interruption of Educational Activities

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This study aimed to verify the long-term effects of an oral-health-promotion program for 203 schoolchildren 24 months after the interruption of educational activities. They were clinically examined to assess dental plaque and gingival bleeding at baseline, immediately after the educational phase (EP), and 12 and 24 months after withdrawal of the EP. The mean plaque scores gradually increased after interruption of the EP, and in the last assessment they were higher than the baseline scores, but similar to the ones verified 12 months after withdrawal of the EP. The mean gingival bleeding scores were maintained after interruption of the EP. However, it was verified that in the last assessment they were lower than the previous evaluations. And, in all analyses, it was far from the baseline mean scores ($P < 0.05$). Analysis indicated that the duration of the program favorably influenced its outcome.

Key words: *dental health education, oral health promotion, dental plaque, gingival bleeding, schoolchildren*

J Clin Pediatr Dent 32(1): 37–42, 2007

INTRODUCTION

There is convincing evidence that dental plaque is the direct cause of gingival inflammation.[1] It is also generally agreed that plaque constitutes one of the primary factors contributing to the initiation of periodontal disease,[2] and that periodontal breakdown is the result of an imbalance in the interaction between plaque constituents and host defense mechanisms.[3]

Some studies[4-6] have shown that efficient and regular plaque control is the crucial factor in combating gingivitis. Furthermore, there is evidence that primary prevention can have a beneficial effect on the prevalence of periodontal breakdown in the population.[7]

Several programs have been designed to study the effect, on oral health, of the improvement of oral hygiene through mechanical plaque control.[2,5,8] A significant part of these programs has been designed for children and young adults. This seems reasonable since it is more feasible to modulate habits at a young age, whereas established practices in adults are usually more difficult to modify.[7]

Nevertheless, according to Sheiham,[9] children do not learn new behaviors through passive absorption, but through activity. Therefore, for most of the last and this century, dental health education has been considered an important part of dental health services in producing behavioral change.[10] The educational interventions used have varied considerably, from the simple provision of information to the use of complex programs involving psychological and behavioral change strategies.[11]

However, there remain some unanswered questions: How much time is needed to acquire effective habits and skills? Are oral health educational programs capable of instilling permanent, desirable habits of oral hygiene, or do the benefits regress with time?[12] Besides, the increasing pressure on health-care resources means that questions are being raised about the costs and effectiveness of all forms of health services.[11] Therefore, in order to obtain reliable data on the

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duration of the effects of oral-health-promotion measures, follow-up studies should be performed at designated intervals after the end of preventive programs.[13] The purpose of this study was to evaluate the long-term effects of an oral-health-promotion program for schoolchildren 24 months after the interruption of educational activities.

MATERIAL AND METHODS

A group of children of both sexes attending a public school in Rio de Janeiro, Brazil, formed the study population. Their parents approved their enrollment in the study, which had been approved by the local ethics committee.

The selected sample consisted of all the children enrolled in the program who had their examinations completed before the beginning of the program (M1 = milepost 1), immediately after its educational stage (M2 = milepost 2), and those verified 12 months after suspension of the educational activities (M3 = milepost 3), amounting to 248 children.

Oral preventive program

The program consisted of the free distribution, every 6 months, of an oral hygiene kit consisting a dental gel, dental biofilm indicator paste, and a child's toothbrush. Information concerning oral hygiene was given and, supervised brushing with the indicator paste was done during the first 6 months of the program, which lasted 30 months. No particular brushing technique was chosen because we judged it more appropriate to improve the technique already used by each child.

In addition, educational activities about oral-health promotion were instituted by a dentist during this same 6-month span. The aim of these activities was to motivate the children to remove plaque through tooth brushing.

Before initiation of the program, we interviewed the children's parents to supply them with information about the etiology, progression, and treatment of dental caries and periodontal disease. The importance of at least 2 daily brushings was emphasized,[14] one in the morning and the other at bedtime, with special emphasis on the quality of the brushing. The use of dental floss was encouraged as well, but dietary counseling was not given.[15] Parents were instructed to supervise tooth brushing at home and to use the dental biofilm indicator paste once a day. Further, a dentist treated the children at school twice a week according to their needs.

Clinical Examinations

The baseline examination took place in 2001 (M1); the second was carried out immediately after the educational phase of the program (M2), which lasted 6 months; the third occurred in 2002, 12 months after suspension of the educational activities (M3); and the final examination took place in 2003, 24 months after interruption of the educational activities (milepost 4 = M4).

The examinations were carried out by 3 trained examiners in a classroom at the school with the aid of a flashlight, with the child lying on a chair. M1 and M2 were conducted by examiner 1; M3 was carried out by examiner 2, and the final milepost of the study, M4, was concluded by examiner 3. The examiners sat behind the children, whose heads were resting on the examiners' laps. For each child, the presence of bleeding after papillary stimulation, according to the Eastman Interdental Bleeding Index (IBI),[16] was assessed. Then the vestibular and lingual surfaces of every tooth were dyed, inspected, and classified according to the Dental Biofilm Index (DBI) of Quigley-Hein and modified by Turesky *et al.*[17] Furthermore, an assistant took notes of all the scores, referring to each examination on an appropriate card.

The individual bleeding index was obtained by calculating the proportion of bleeding sites in relation to nonbleeding ones, and the biofilm average was obtained by adding the scores of each surface and dividing the result by the number of analyzed surfaces.

Reproducibility

Before beginning the M1 examinations, examiner 1 was trained by postgraduate teachers. Then examiner 2 was trained by examiner 1 for the clinical exams performed in 2002 (M3), and examiner 3 was trained by examiner 2 for the exams performed at M4, for both DBI and IBI. We did not consider it necessary to repeat the calibration, because dental biofilm and interdental bleeding are clinical signs that can change over a short time.

However, intra- and interexaminer reliability tests were performed with examiners 2 and 3 for DBI using the photographic method developed by Kelly *et al*.[18] The intraclass correlation coefficient of 0.849 was found for intra examiner 2 agreement and 0.837 for intraexaminer 3 agreement. Inter examiner agreements of 0.998 (clinical examinations) and 0.984 (photographic examinations) were also verified.

Data analyses

All data were analyzed in the SSPS 11.0 version. For statistical analyses, nonparametric tests were used. The Friedman test was used to compare more than 2 dependent numerical variables. This analysis was complemented with the Wilcoxon test with Bonferroni correction for the analysis of 2-by-2 variables. Independent variables were compared by means of the Mann-Whitney test. Spearman correlation coefficient tests were also performed to assess correlation between the 2 indicators. For all analyses, the significance level was considered to be 5%.

RESULTS

Owing to the loss of 45 children (22%) from the original sample (n = 248), mainly because of transfer to another

Table 1. Percentual distribution of children as to gender sex and age average (n = 203)

GenderSex	n(%)	Age
		X ± SD
F	115 (56.7)	9.20 ± 0.83
M	88 (43.3)	9.11 ± 0.71

Table 2. Dental Biofilm Index (DBI) at mileposts of assessment (n = 203)

	IBD				
	Mean	Std. Deviation	Median	Minimum	Maximum
M1	2.14	0.40	2.09	1.38	3.95
M2	1.71	0.29	1.67	1.00	2.91
M3	2.03	0.46	2.01	0.84	3.52
M4	2.05	0.62	1.91	1.06	4.09

Note: Friedman test, $P < .05$.

Table 3. Comparison between DBI mean at mileposts of assessment (n = 203)

	M1	M2	M3	M4
M1	-	$P < .001$*	$P = .004$*	$P = .021$
M2	0.42	-	$P < .001$*	$P < .001$*
M3	0.11	0.32	-	$P = .828$
M4	0.09	0.33	0.02	-

Note: The lower triangle represents the difference between DBI averages; the upper, the *P* value of the respective comparison.
*Assumed significance $P < .008$ (Bonferroni).

Table 4. Interdental Bleeding Index (IBI) at mileposts of assessment (n = 203)

	IBI				
	Mean	Std. Deviation	Median	Minimum	Maximum
M1	0.090	0.10	0.05	0.00	0.56
M2	0.019	0.05	0.00	0.00	0.30
M3	0.022	0.05	0.00	0.00	0.38
M4	0.016	0.03	0.00	0.00	0.21

Note: Friedman test, $P < .05$.

school, the final sample at all 4 mileposts of the study consisted of 203 children. The percentile distribution of the children by sex and age can be seen in Table 1.

The children's oral health improved during the first 6 months of the program: There was a significant drop in the average DBI of the second evaluation (M2) as compared with M1. However, at the last assessment (M4), it was higher than the evaluation made immediately after the educational phase (M2) ($P < 0.05$), but similar to the one verified 12 months after withdrawal of the educational component (M3) ($P > 0.05$) (Tables 2 and 3).

In relation to IBI, a statistically significant drop ($P < 0.05$) was observed between M1 and M2. The mean gingival bleeding scores increased after interruption of the educational activities (M3). However, the lowest IBI average

Table 5. Comparison between IBI means at mileposts of assessment (n = 203)

	M1	M2	M3	M4
M1	-	$P < .001$*	$P < .001$*	$P < .001$*
M2	0.07	-	$P = .656$	$P = .051$
M3	0.07	0.00	-	$P = .073$
M4	0.08	0.01	0.01	-

Note: The lower triangle represents the difference between IBI averages; the upper, the P value of the respective comparison.
*Assumed significance P < .008 (Bonferroni).

Table 6. Correlation between DBI and IBI at mileposts of assessment (Spearman test)

DBI ×IBI	M1	M2	M3	M4
r (*P* value)	0.159 (= 0.024)	0.105 (= 0.138)	0.204 (= 0.004)	0.323 (<0.001)

Note: r = Spearman correlation coefficient ($P < .05$);
P value = correlation significance level.

of the study was found at M4 (Table 4). All the differences between IBI assessments are shown in Table 5. Concerning the correlation between biofilm buildup and the presence of interdental bleeding, the results indicate a correlation between IBI and DBI in M1, M3, and M4 (Table 6).

DISCUSSION

This investigation was undertaken to determine the efficacy of an oral–health- promotion-program in controlling dental plaque and preventing gingival inflammation in schoolchildren, even after suspension of the program's educational activities. A control group was not included because we considered it unethical to limit the benefits of such a program to a part of the population. Furthermore, for the study to be controlled and to make a reliable assessment of the measures' effectiveness, the control group should have no contact with the participating children, to prevent the "contamination effect" mentioned in literature.[2,10] This effect would become a further limiting factor to the study at the same school—contact between groups being unavoidable—and the formation of a control group at another school, to be assessed over time without a single benefit in exchange, seemed needless.

The aim of this study was to evaluate the extent to which the educational procedures of the program have been effective in changing the schoolchildren's behavior, starting at the suspension of these procedures. Some studies have concluded that information about oral health furnished during such a program has been neither efficient nor effective in plaque control.[19,20] Furthermore, Ivanovic and Lekic[13] have observed that improvement in oral health resulting from an educational preventive program was only temporary and that the reduction in biofilm and gingival inflammation achieved during the program dissipated after its cessation. These authors have stressed the importance of periodic evaluation after the end of the program to ascertain its long-term effect.

Still concerning the methodology of the study, IBI inter- and intra-examiner calibrations were not performed because both the giving of the test and the interpretation of its

results—that is, the presence or absence of bleeding in each examined interdental space—is considered extremely simple. Blieden *et al*[22] and Marks[23] have stated that gingival bleeding, when assessed through a dichotomic criterion, is a highly reproducible sign in repeated examinations.

We have ascertained that during the first 6 months of the program, while educational activities were being conducted, there was significant improvement in the dental biofilm average (Table 2) as well as in the dental bleeding of the children under study. These results corroborate those of other studies,[8,10] in which the individuals included in the programs were involved in educational activities and in which the information received contributed to their oral health.

In the evaluation after suspension of the program's educational activities (M3), the average of both indicators showed a worsening compared with those found at M2. Nevertheless, these values did not return to the levels verified before the beginning of the program (Tables 2 and 4). Similar results were mentioned by Worthington *et al*,[10] but Ivanovic and Lekic[13] disagree with these data. These authors report that 6 months after the end of the program, the amount of biofilm and gingival inflammation had significantly increased, returning to baseline levels.

After 24 months without the educational activities of the program (M4),we verified that the IBI average was the best shown in the study and that the dental biofilm index, though increased compared with that found at M3, did not represent a statistically significant difference ($P > 0.05$). These results corroborate the ones found by Albandar *et al*,[2] in which improvement in the analyzed indicators was observed only at the end of the 3-year program, as opposed to the results found after its first year. According to these authors, this indicates that the observed improvement was a consequence of the duration of the program. We believe that the results found in M4 of our study are directly correlated with both the dentist's holding a weekly clinic at the school—even after suspension of the educational activities—and the duration of the program, during which the children continued to receive oral hygiene kits.

According to Listgarten[24] and Kozlovsky and Zubery,[25] biofilm growth on the proximal surfaces can cause localized gingivitis in a few days. This concept is in accordance with the results found at 3 mileposts of this study (M1, M3, and M4), which refer to the correlation between dental biofilm and gingival bleeding indexes. However, this correlation was not verified at M2. Therefore, it cannot be refuted that part of this result might be attributed to a measurement error. Besides, the verified correlations were slight,[26] although statistically significant. However, the correlations in M1 and M3 were slighter, probably because not all bleeding sites were due to plaque accumulation, but rather to tooth eruption.

We have ascertained that at M1 the results regarding gingival bleeding were not similar to any other verified at the remaining mileposts of the study, thus differing from the other adopted indicator (DBI). Even before the beginning of the program the DBI presented significantly different averages, but without glaring disparities at any milepost. This might be attributed to the gingivitis that frequently occurs during exfoliation of primary teeth and eruption of the permanent ones—the resultant discomfort causing a decreased frequency in brushing[27]—for at the time of M1 assessment there were probably many erupting and exfoliating teeth among the children in this sample. This conclusion arises from the fact that 30 months later, at the study's last milepost (M4), 80.3% of the children were between 9 and 10—most of them at the late mixed-dentition stage—with fewer erupting teeth.

Julien[21] demonstrated that the improvement in the biofilm indexes made during the program was already more pronounced than that of a control group 1 year after cessation of all program activities, as shown by the reassessment then made. The sample consisted of 10-year-old schoolchildren enrolled in a health education program. In our study, in view of the sample focused and the methodology used, it was found that the positive results attained during the first 6 months, with reinforcement by the educational activities, were not dissipated during the 2-year period following its cessation; this indicates that a relative change of behavior had been achieved, as found by Julien[21] in his study.

In this study, we observed that even after the suspension of the educational activities of the oral-health-promotion program, there was no loss of the previously achieved benefits, demonstrating that both the imparted information and the fostered motivation were retained. Nevertheless, note should be taken of the fact that these children have remained in weekly contact with the school dentist, even after cessation of the program's educational activities. They also continued to receive oral hygiene kits, suggesting that, no matter how minimal their contact with some kind of oral health motivation, it was enough to prevent complete dissipation of the positive results previously achieved.

ACKNOWLEDGEMENT

We express our thanks to the school dentist, Dr. Thaís Ferreira Neves, without whose enthusiasm and willing cooperation, this investigation would not have been possible.

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