A Health Education Program for Brazilian Public Schoolchildren: The Effects on Dental Health Practice and Oral Health Awareness

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Abstract

Objectives: *Determine the impact of an oral health education program on oral hygiene and the awareness level of elementary schoolchildren.* ***Methods:*** *A total sample of 247 schoolchildren between the ages of 7 and 15 years from the public school system of Parnamirim, Brazil, were selected and randomly allocated to a control (*n *= 115) and experimental (*n *= 132) group. Sociodemographic data were recorded and a clinical examination was given to establish the decayed, missing and filled surfaces index (DMFS) and the dmfs index. The visible plaque index (VPI) and gingival bleeding index (GBI) were collected before and after the intervention. A closed-question questionnaire was applied to the schoolchildren before and after intervention to determine their knowledge of oral health. The experimental group took part in oral health education activities over a 4-month period.* ***Results:*** *The VPI (*P *= 0.014; CI 0.24-0.86) and GBI (*P *= 0.013; CI 0.28-0.87) of the experimental group were significantly lower after educational activities. Similarly, the experimental group also obtained a higher number of correct answers on the questionnaire (*P *< 0.0001; CI 3.73-26.81). However, there was no association between oral hygiene indicators, VPI (*P *= 0.311; CI 0.23-1.60), and GBI (*P *= 0.927; CI 0.43-2.16), and the information level of the schoolchildren.* ***Conclusions:*** *Contextualized educational activities in the school routine had positive effects on oral hygiene and the level of information about oral health, although the more informed individuals did not always practice better oral hygiene.*

Key Words: dental health education, school health, oral health

Introduction

Dental caries and periodontal disease have a common characteristic that favors their development inside the oral cavity: the presence of dental bacterial plaque, currently called dental biofilm. Dental biofilm is the primary etiologic agent of the main oral diseases, and its specific nature depends on the microorganisms that colonize it (1,2).

The prevalence of these diseases has been analyzed for decades in epidemiological studies and has shown a large worldwide decrease in recent years (3,4). In Brazil, a significant decline has occurred in 12-year-olds over the years. In 1986, the number of decayed, missing, and filled teeth was 6.7; in 1993, it was 4.8; in 1996, it was 3.1; and in the latest survey (5), it had decreased to 2.78 (6).

According to the World Oral Health Report 2003 (7), despite great achievements in the oral health of populations globally, problems still remain in many communities around the world – particularly among underprivileged groups in developed and developing countries (7).

Brazil has a wide variability in the distribution of decayed, missing and filled index (DMF) values, with a concentration in the number of caries in lower income individuals who do not have access to dental services (5).

The recent representative survey in Brazil (5) assessed the periodontal health of 12-year-old children. The indices show that more than 50% of this population has gingival bleeding or calculus, demonstrating that their oral hygiene conditions are at an alarming level.

A number of well-planned preventive/educational programs, based on the mechanical control of dental biofilm and on the motivation of individuals, have obtained favorable results in reducing dental biofilm (8-10). However, according to Kay and Locker (11), educational oral health programs have a small positive effect, which temporarily reduces dental biofilm, and there is no impact on dental caries. In the same way, awareness levels can almost always be improved by oral health promotion initiatives. However, whether these shifts in knowledge and attitudes can be causally related to changes in behavior or clinical indices of disease has not yet been established (11).

It is surmised that well-designed educational intervention studies may improve oral hygiene indices and awareness levels in children, although this does not imply an effective change in habits.

This controlled randomized study, carried out over a 4-month period at 2-week intervals with children from the third and fourth grades of public elementary schools, proposes to

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a) assess the effects of the oral health education program in reducing visible plaque and gingival bleeding and improving oral health knowledge; b) identify factors other than educational intervention that interfere with oral hygiene indicators visible plaque index (VPI) and gingival bleeding index (GBI); and c) identify the association between oral health information levels and hygiene indices.

Methods

A blind randomized control intervention was carried out in two municipal public schools located in neighboring suburban districts of Parnamirim, Brazil. Mean monthly income in these districts is twice the monthly minimum wage (≈US$333.00).

The sample comprised 247 third and fourth grade children, including 7- to 15-year-olds. There was a wide age range of schoolchildren, as many Brazilian children are behind by one or more grades owing to high failure rates. Classrooms were then drawn and randomly assigned, with two in the experimental group and two in the control group. The experimental group consisted of 132 children enrolled in an oral health education program. The control group was composed of 115 children who did not take part in the program.

At baseline, all the children received a clinical examination and a self-administered paper questionnaire with 20 multiple choice items about oral health to assess the students' awareness levels on the subject.

The paper questionnaire included questions about the name, function and importance of teeth, tooth pain, dental caries, periodontal disease, fluoride, brushing techniques and use of dental floss, thumb sucking, pacifier use, and malocclusion, among others. The multiple-choice questionnaire was applied before and after intervention.

The questionnaire was pretested for ambiguity and ease of understanding in a pilot study with 56 children from another school, of similar age and socioeconomic characteristics.

Personal data of the children were recorded and a calibrated examiner performed an intra-oral examination for dental caries, oral hygiene, and gingival condition. They were examined in the schools under natural daytime light in an open place with aid of a dental mirror and a World Health Organization (WHO) periodontal probe.

The clinical diagnosis of caries was made after cleaning and drying the surface prior to examination. Dental caries were recorded using the criteria described by the WHO (12) for the classification of tooth surface caries status, as follows: decay, missing-due-to-decay (or extraction advised), or filled permanent and primary surfaces (DMFS and dmfs). The index of agreement for DMFS was 0.82.

Oral hygiene was measured using the VPI and GBI (13). The percentage of plaque and bleeding sites after probing was calculated for each child. The plaque score was recorded at the beginning and at the end of the intervention.

About 1 week after the clinical examination and questionnaire application, the dentist commenced the 4-month (two sessions per month) dental health education program, conducted in a classroom with the experimental group, totaling eight 1-hour lessons. Participatory, descriptive classes using chalk and blackboard, illustrative and educational drawings, dental mannequins, and dynamic competitive games were featured at these meetings.

One month after the end of the educational activities, a final evaluation of all participants was carried out, using the questionnaire, the VPI, and the GBI (13). A period of 1 month was needed to determine whether the contents of the lessons were in fact incorporated into the children's lives, and because reduction in gingival bleeding index is observed over time.

Descriptive statistics were used to summarize the results. Dichotomous variables were compared at baseline using the chi-square test and the Mann–Whitney test for the quantitative variables.

Wilcoxon's test was used to compare the initial and final VPI and GBI among the groups. The homogeneity of the variances was assessed by the Kolmogorov–Smirnov test.

The association between GBI, VPI, number of correct answers on the questionnaire after intervention and baseline variables (gender, age, VPI, GBI, DMFS, dmfs) was calculated using the chi-square test and multiple logistic regression analysis. The Hosmer–Lemeshow test was used to verify the goodness of fit of the model.

The continuous variables were dichotomized using the median value as the cut-off point. Children obtaining 50% or more correct answers (10 correct answers for a total of 20 questions) were considered to have satisfactory oral health knowledge index, whereas children with less than 50% were considered unsatisfactory.

Previous permission was obtained from the directors of the schools where the classes were given. The authorization to take part in the study was also obtained from the children's parents or guardians. In addition, the control group children took part in educational activities after data collection. The project was approved by the Research Ethics Committee of the Universidade Federal do Rio Grande do Norte, under protocol 057/2006, according to Resolution 196/96 of the National Health Council.

Results

Of the original study population of 247, 52 children (21.1%) transferred to other schools or dropped out. The 195 remaining children were similarly distributed in both groups ($P = 0.68$).

The demographic and clinical characteristics were equally distributed between the two groups, demonstrating the homogeneity of the sample studied (Table 1).

Table 2 shows that the final plaque ($P = 0.014$, OR = 0.46, CI =

Table 1
Baseline Demographic and Clinical Characteristics of the Study Groups. Parnamirim-Brazil, 2008

Variable	Groups		*P*
	Control	Experimental	
Sex			
Male	61 (53.0%)	69 (52.3%)	0.99*
Female	54 (47.0%)	63 (47.7%)	
Age group (mean ± SD)	10.16 ± 1.54	9.8 ± 1.69	0.08†
Baseline VPI (mean ± SD)	34.58 ± 20.28	29.74 ± 18.56	0.17†
Baseline GBI (mean ± SD)	8.42 ± 11.88	9.23 ± 13.02	0.62†
DMFS (mean ± SD)	4.03 ± 5.88	3.11 ± 4.85	0.20†
dmfs (mean ± SD)	2.84 ± 4.84	2.88 ± 3.91	0.94†
Baseline correct answers (mean ± SD)	4.33 ± 2.40	4.22 ± 2.97	0.79†

* Descriptive level of the chi-square association test.
† Mann–Whitney test.
VPI, visible plaque index; GBI, gingival bleeding index; DMFS, decayed, missed, filled permanent tooth surface; dmfs, decayed, missed, filled deciduous tooth surface; SD, standard deviation.

0.24-0.86) and gingival bleeding ($P = 0.013$, OR = 0.49, CI = 0.28-0.90) indices decreased more in the experimental group. It further shows that there was a statistically significant difference ($P < 0.001$) between the number of correct answers in the questionnaire after the educational intervention. For example, the control group had a 10-fold greater likelihood of obtaining wrong answers.

Figures 1 and 2 show the VPI and GBI means per group at the start and at the end of the intervention. A significant drop in both the PVI and GBI was found in the experimental group, whereas GBI remained unchanged in the control group.

Table 3 shows that the variables baseline VPI and GBI, age, and DMFS were statistically associated to the final GBI. However, after multivariate analysis, only the variables group ($P = 0.045$, ORaj = 0.52) and age ($P = 0.012$, ORaj = 2.34) had an independent effect on low GBIs.

There was no association between oral hygiene indices (VPI final – $P = 0.76$ and GBI final – $P = 050$) and the number of correct answers.

Discussion

A school is a closed environment that concentrates a considerable number of individuals of the same age group who regularly attend the institution. For this reason, it has been considered ideal for developing health and oral hygiene programs with children in age groups that are favorable for adopting preventive measures (14,15). Moreover, oral health behavior is a result of a lifelong learning process; this process can best be achieved by an interdisciplinary collaboration among dentists and professionals in other areas, such as psychologists and teachers (16).

A structured and systematic approach to dental care for schoolchildren may result in good oral health and may be economically profitable for a society with an organized public dental service for schoolchildren (17).

A significant improvement in oral hygiene was obtained in this study, showing that the group of students who took part in dynamic educational activities in a classroom setting for a period of 4 months had lower visible plaque and gingival bleeding indices than those of the control group. Educational activities, therefore, are a protection factor against the accumulation of dental biofilm and the development of gingival alterations.

Similar results were found by Toassi and Petry (18) in a study on motivation in the control of dental biofilm and gingival bleeding, in which there was a statistically significant difference between the control and experimental group in relation to GBI and PVI, favoring the group that was enrolled in the educational program.

An analysis performed before and after educational activities in the experimental group showed an improvement in oral hygiene, with a reduction in both dental biofilm and gingival bleeding. These findings corroborate two non-controlled studies, which found statistically significant decreases in dental biofilm (8,19).

A decreased plaque index occurred in 34.5% of the children, a slightly higher value than those found in systematic reviews (20,21), which reported reductions of less than 30%. However, the effect was considered short term.

Another interesting finding in this study was that the control group, even without directly taking part in the educational intervention, had decreased plaque index. The increased number of biofilm-free tooth faces may have occurred as a result of the Hawthorne effect (22). The mere presence of the dentist in the school and the possibility of greater dental attention provided to the students likely had some influence in motivating them to better self-care. This fact was also verified by Toassi and Petry (18), where 45.9% of the control group decreased visible plaque values between the initial and the final examinations, 37.7% maintained the same index and 16.4% increased it. Nevertheless, this effect did not produce improved gingival bleeding values.

In relation to factors that could influence the outcome, as well as educational activities, it was observed that the baseline hygiene indices had the greatest influence. That is, the children with less dental biofilm and gingival bleeding at the beginning of the study had a greater chance of remaining unchanged after the experimental period. These children already had good brushing habits, and it is supposed that the educational activities only reinforced these practices. However, the predominant

Table 2
Number and Percentage of Final VPI, GBI, and Correct Answers in Experimental and Control Groups. Parnamirim-Brazil, 2008

		Groups						
		Control		Experimental				
Variable	Classification	*n*	%	*n*	%	*P*	OR	CI
VPI	Satisfactory	58	42.0	80	58.0	0.014*	0.46	0.24-0.86
	Unsatisfactory	35	61.4	22	38.6			
GBI	Satisfactory	41	39.4	63	88.6	0.013*	0.49	0.28-0.90
	Unsatisfactory	52	57.1	39	42.9			
Correct answers	Satisfactory	82	56.2	64	43.8	<0.001*	10.00	3.72-26.8
	Unsatisfactory	5	11.4	39	88.6			

* Statistically significant difference.
OR, odds ratio; CI, confidence intervals; VPI, visible plaque index; GBI, gingival bleeding index.
Chi-square test.

Figure 1
Means and standard deviation (%) of the visible plaque indices of the control and experimental group before and after the educational intervention. Parnamirim-Brazil, 2008

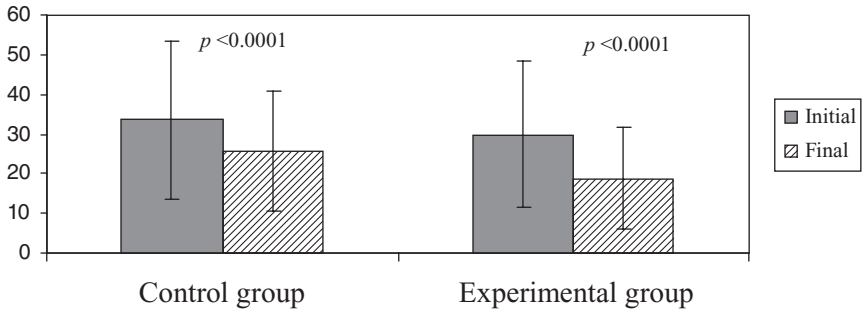
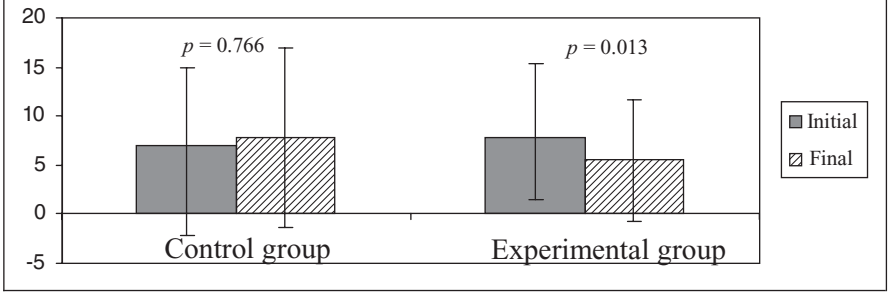


Figure 2
Means and standard deviation of the gingival bleeding indices of the control and experimental group before and after the educational intervention. Parnamirim-Brazil, 2008



effect was from theeducational intervention, given that in multivariate analysis the oral hygiene indices lost statistical association.

The 7- to 9-year-old age group obtained the best oral hygiene results and this may have been due to the motivation of these students, as a result of the educational resources used in the school. However, the activities used for this age group may not have been as exciting for the many older children present in these classrooms.

The caries index (DMFS) also showed a significant association with the final GBI in bivariate analysis, demonstrating that individuals with fewer caries were less likely to develop gingivitis. This was probably because the individuals in question had healthy teeth, which does not cause discomfort and favors proper cleaning in the region. This might avoid the evolution of dental biofilm and the consequent onset of gingivitis. However, this effect was lost on multivariate analysis.

As to the results obtained on the questionnaires, a greater number of correct answers were found in the experimental group after educational intervention, leading us to conclude that the students who took part in the activities had greater likelihood of increasing their awareness of oral health issues.

Similar results were observed in a study carried out by Biesbrock *et al.* (19), who compared the oral health knowledge of children in the United States before and after a 5-month educational program with monthly visits. They found a statistically significant difference ($P < 0.05$) in increased information on healthy habits. Similarly, Aquilante *et al.* (23), in an educational intervention study performed with schoolchildren in Bauru, Brazil, found an increased oral health awareness level ($P > 0.001$).

The results obtained here suggest that educational activities using

Table 3
Logistic Regression Model for Gingival Bleeding Index after the Intervention. Parnamirim-Brazil, 2008

Variable	Category	Overall OR	CI (OR overall)	*P*	Adjusted OR	CI (adjusted OR)	*P*
Group	Control Experimental	0.49	0.27-0.86	0.013*	0.52	0.28-0.99	0.045*
DMFS	High Low	2.00	1.12-3.58	0.018*	1.23	0.64-2.37	0.525
Age	7 to 9 years 10 to 15 years	2.15	1.21-3.82	0.008*	2.34	1.20-4.54	0.012*
Baseline VPI	High Low	2.22	1.24-3.97	0.007*	1.93	0.98-3.78	0.055
Baseline GBI	High Low	2.52	1.40-4.54	0.002*	1.92	0.99-3.71	0.052

Hosmer–Lemeshow test: $P = 0.66$.
* Statistically significant difference.
OR, odds ratio; CI, confidence intervals; VPI, visible plaque index; GBI, gingival bleeding index; DMFS, decayed, missed, filled permanent tooth surface.

participatory methods with schoolchildren are capable of producing positive effects when they acquire new information about oral health. This finding corroborates the meta-analysis conducted by Kay and Locker (20), who showed that oral health education had a positive and consistent effect on awareness levels.

However, another important finding was the absence of any association between oral hygiene indicators and the number of correct answers, which suggests that those who are more aware of oral health do not necessarily practice better oral hygiene.

Similar results were found by Aquilante (23) and Tomita *et al*. (24), who measured the relation between theoretical knowledge and the plaque index at the end of the study, using Spearman's correlation coefficient, and found no statistical significance. It has been observed that the social environments in which children live (family, friends, teachers, etc.) are mainly responsible for their motivation to perform any activity. Parents' knowledge and attitudes about the importance of oral health care and their fears about dental treatment influenced their children's dental care (25). It is important to point out that the routine of toothbrushing and oral health care in schoolchildren depends mainly on the parents at home and on the teachers at school. This teacher–parent collaboration helps ensure the success of the programs and continued health care.

The study showed that oral health education in schools had a positive effect on students' oral hygiene and on their information levels. These effects, regardless of impact, will act directly or indirectly on their lives. There are no studies proving the influence of educational activities; however, there are none that rule it out (21).

The consistency of this effect can only be achieved through a long-term program using educational activities in the school routine, given that health education is a process that informs, motivates, and helps people adopt and maintain good health practices and healthy lifestyles (26).

School dental services may add to population strategies for preventing caries among children by providing dental health education and specific preventive measures, particularly to high-risk children (27).

This study confirmed that an oral-care school initiative can lead children to be motivated to maintain oral health care, and that this educational program increases oral health status by reducing dental plaque and gingival bleeding. The short-term benefits in awareness and consequently, for health, can be more effective with a continuous school-based health program involving dentists, teachers, parents, and children.

References

1. Beighton D. The complex oral microflora of high-risk individuals and groups and its role in the caries process. Community Dent Oral Epidemiol. 2005;33:248-55.
2. Yoo SY, Park SJ, Jeong DK, Kim KW, Lim SH, Lee SH, Choe SJ, Chang YH, Park I, Kook JK. Isolation and characterization of the mutans streptococci from the dental plaques in Koreans. J Microbiol. 2007;45(3):246-55.
3. White BA, Caplan DJ, Weintraub JA. A quarter century of changes in oral health in the United States. J Dent Educ. 1995; 59(1):19-57.
4. Nadanovsky P, Sheiham A. Relative contribution of dental services to the changes in caries levels of 12-year-old children in 18 industrialized countries in the 1970s and early 1980s. Community Dent Oral Epidemiol. 1995;23(6):331-9.
5. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. Projeto SB Brasil 2003: condições de saúde bucal da população brasileira 2002-2003: resultados principais. Brasília: Ministério da Saúde; 2004. 68 p.
6. Narvai PC, Frazão P, Roncalli AG, Antunes JLF. Dental caries in Brazil: decline, polarization, inequality and social exclusion. Rev Panam Salud Publica. 2006;19(6):385-93.
7. World Health Organization. The World Oral Health Report 2003: continuous improvement of oral health in the 21st century – the approach of the WHO Global Oral Health Programme. Geneva, Switzerland: World Health Organization. 2003. 45 p.
8. Albandar JM, Buischi YAP, Mayer MPA, Axelsson P. Long-term effect of two preventive programs on the incidence on

plaque and gingivitis in adolescents. J Periondotal. 1994;8(2):278-84.
9. Worthington HV, Hill KB, Mooney J, Hamilton FA, Blinkhorn AS. A cluster randomized controlled trial of a dental health education program for 10-year-old children. J Public Health Dent. 2001; 61(1):22-7.
10. Petersen PE, Peng B, Tai B, Bian Z, Fan M. Effect of a school-based oral health education programme in Wuhan City, Peoples' Republic of China. Int Dent J. 2004;54:33-41.
11. Kay E, Locker D. A systematic review of the effectiveness of health promotion aimed at improving oral health. Community Dent Health. 1998;15(3):132-44.
12. World Health Organization. Oral health surveys: basic methods. 4th ed. Geneva: ORH/EPID; 1997.
13. Ainamo J, Bay I. Problems and proposals for recording gingivitis and plaque. Int Dent J. 1975;25:229-35.
14. Boyer ME, Phil M. Classroom teachers' perceived role in dental health education. J Public Health Dent. 1976;36(4): 237-43.
15. Vasconcelos R, Matta ML, Pordeus IA, Paiva SM. School: an important information place on oral health care for the child population. PGR-Pós-Grad Rev Fac Odontol São José dos Campos. 2001; 4(3):43-8.
16. Makuch A, Reschke K. Playing games in promoting childhood dental health. Patient Education and Counseling. 2001; 43(1):105-10.
17. Wendt LK, Carlsson E, Hallonsten AL, Birkhed D. Early dental caries risk assessment and prevention in pre-school children: evaluation of a new strategy for dental care in a field. Acta Odontol Scand. 2001;59(5):261-6.
18. Toassi RFC, Petry PC. Motivação no controle do biofilme dental e sangramento gengival em escolares. Rev Saúde Pública. 2002;36(5):634-7.
19. Biesbrock AR, Walters PA, Bartizek RD. Initial impact of a national dental education program on the oral health and dental knowledge of children. J Contemp Dent Pract. 2003;4(2):1-7.
20. Kay EJ, Locker D. Is dental health education effective? A systematic review of current evidence. Community Dent Oral Epidemiol. 1996;24:231-5.
21. Watt RG, Marinho VC. Does oral health promotion improve oral hygiene and gingival health? Periodontol 2000. 2005; 37:35-47.
22. Feil PH, Grauer JS, Gadbury-Amyot CC, Kula K, McCunniff MD. Intentional use of the Hawthorne effect to improve oral hygiene compliance in orthodontic patients. J Dent Educ. 2002;66(10):1129-35.
23. Aquilante AG, Almeida BS, Castro RFM, Xavier CRG, Peres SHCS, Bastos JRM. A importância da educação em saúde bucal para pré-escolares. Rev Odontol UNESP. 2003;32(1):39-45.
24. Tomita NE, Pernambuco RA, Lauris JRP, Lopes ES. Educação em saúde bucal para adolescentes: uso de métodos participativos. Rev. FOB. 2001;9(1/2):63-9.
25. Al-Omiri MK, Board J, Al-Wahadni AM, Saeed KN. Oral health attitudes, knowledge, and behavior among school children in North Jordan. J Dent Educ. 2006; 70(2):179-87.
26. Ide R, Mizoue T, Tsukiyama Y, Ikeda M, Yoshimura T. Evaluation of oral health promotion in the workplace: the effects on dental care costs and frequency of dental visits. Community Dent Oral Epidemiol. 2001;29:213-19.
27. Gaughwin A, Spencer AJ, Brennan DS, Moss J. Oral health of children in South Australia by socio-demographic characteristics and choice of provider. Community Dent Oral Epidemiol. 1999;27: 93-102.