SH Al-Jundi
M Hammad
H Alwaeli

The efficacy of a school-based caries preventive program: a 4-year study

Authors' affiliations:
Suhad H Al-Jundi, *M Hammad*, *H Alwaeli*, Department of Preventive Dentistry, Jordan University of Science and Technology, Irbid, Jordan

Correspondence to:
Dr Suhad H. Al-Jundi
Department of Preventive Dentistry
Jordan University of Science and Technology
PO Box 810053
Irbid
Jordan
E-mail: suhadj@just.edu.jo

Abstract: This longitudinal study aimed at testing the efficacy of a school-based caries preventive program, by comparing dental caries status of two groups, a study group (436 children) and a control group (420 children) over a period of 4 years. The study group received a preventive program which consisted of intensive oral hygiene instructions sessions, and supervised daily tooth brushing using fluoridated tooth paste in schools. The control group received only oral hygiene instructions sessions. Annual dental examination to record dental caries status, using Decayed Missed Filled Teeth Index (DMFT) and deft, was conducted for both groups over a period of 4 years. At the end of the fourth year the efficacy of the program was tested by comparing the DMFT and deft indices for the two groups using Pearson chi-square test and Cochran–Mantel–Haenzele test. The level of significance was set at $P < 0.05$. The results after 4 years showed that the caries status of the children in the study group was better than that of the control group. The difference was statistically significant (*P*-value 0.001). The estimates of relative risk values also showed that children in the control group are 3.1 and 6.4 times at higher risk of having dental caries than those in the study group for age group 12 and 6 respectively. This study proves that supervised daily tooth brushing using fluoridated toothpaste is successful in controlling dental caries in children.

Key words: caries; fluoridated prevention; toothbrushing; toothpaste

Dates:
Accepted 6 October 2005

To cite this article:
Int J Dent Hygiene **4**, 2006; 30–34
Al-Jundi SH, Hammad M, Alwaeli H.
The efficacy of a school-based caries preventive program: a 4-year study

Introduction

Dental caries is a disease that affects all age groups and hence prevention is important throughout life. The prevalence and severity of dental caries varies between and within different countries (1).

In developing countries, dental caries is on the increase as indicated by data from the WHO dental data bank, which showed that the mean Decayed, Missing, Filled Teeth Index (DMFT) for 12-year-old children was 4.1 for developing countries and 3.3 for industrialized countries. Twenty years earlier, WHO data indicated that DMFT for most developing countries was less than one (2).

In Jordan, which is a developing country, caries rate is increasing as reflected by the DMFT Index. It was 0.2 in 1962 rising up to 1.7 in 1991 in 12-year-old children (2). A recent report indicated that DMFT Index for 15 to 16-year-old Jordanian children is 4.7–4.9 (3). This calls for urgent action to design proper preventive programs to combat the problem.

The main aim of this longitudinal study is to test the efficacy of a school-based caries preventive program. This is the first controlled study of this kind in Jordan and is expected to help laying down scientific evidence and epidemiological data for future planning of a national-controlled scheme for the prevention of dental caries in children. In addition, it is expected to help establish the budgetary requirements of dental preventive programs.

Methods

In this follow-up study, a random sample of male and female children in the first and sixth grades was drawn from lists provided by four schools in Irbid City.

The study design was approved by the Jordan University of Science and Technology ethics committee. Parents of children selected for the study were sent consent letters describing the procedure. Those who consented to the procedure were enrolled in the study and their parents filled a structured questionnaire to determine oral hygiene practices at home.

All children in the selected schools were included in the study except those with fixed orthodontic appliances or advanced systemic or periodontal disease.

Baseline data for caries experience of the selected children were recorded using the DMFT Index for permanent teeth and deft for primary teeth as recommended by the WHO (4).

Children were examined in the supine position using a mirror and a probe. Illumination of the oral cavity was achieved by using a versatile lamp. Cotton rolls were used to remove debris and saliva where visibility is obscured. The probe was used to remove food and debris from fissures of posterior teeth. The main author performed all examination, and was calibrated for repeatability during the pilot study. Fifty-five children were examined during the pilot study. Each child was examined twice at two different occasions; there was 88% agreement in these occasions. This consistency is acceptable by WHO standards (4), Kappa statistics was found to be 0.77; that is beyond chance there is good agreement. A research assistant recorded examination scores on specially designed examination sheets.

After baseline examination of all children, they were randomly allocated a control group and a study group.

The children in the study group received 30-min oral hygiene instructions sessions on five consecutive school days. These sessions were repeated twice a year in September and in May i.e. at the beginning and the end of school years. The instructions were designed to suit the targeted age group and included a traditional 10-min lecture given by the main author on the importance and methods of oral hygiene utilizing a large coloured poster; in the following 10 min a dental hygienist explained the method of tooth brushing on a large model of the dental arches. In the last 10 min all children practiced tooth brushing using the horizontal scrub method under the supervision of the dental hygienist and the research assistant.

The other component of the program was daily supervised tooth brushing using fluoridated toothpaste and a medium soft brush that was replaced twice a year. The fluoride concentration in the toothpaste was 500 and 1000 p.p.m. for children in the first and sixth grades respectively; no other relevant ingredients were included in the tooth paste. The tooth brushes used were small soft type and were replaced in May and September of each year at the beginning of each oral hygiene instructions sessions. Tooth brushing was carried out as a daily classroom activity and was supervised by a research assistant.

The children in the control group received the same oral hygiene instructions sessions, but without practical demonstration and application of tooth brushing technique.

All children were examined annually in September of each year.

The dental preventive program lasted 4 years. At the end of the fourth year the efficacy of the program was tested by comparing the DMFT and deft indices for the two groups using Pearson chi-square test and Cochran–Mantel–Haenzele (CMH) test. The level of significance was set at $P < 0.05$.

Results

Baseline data

Of the parents who received consent letters 2% refused to allow their children to participate in the study.

A total number of 856 children participated in the study, They were distributed into two age groups: age group 1, mean

age 6.3 years (SD = 0.29) and age group 2, mean age 11.7 years (SD = 0.87).

After baseline examination, the children in the sample were randomly allocated to two cohorts (groups), a study group and a control group (420 in the control group and 436 in the study group). The frequency distribution of the children in the study population is represented in Table 1.

Caries experience for both cohorts as represented by the mean deft for age group 1 and the mean DMFT for age group 2, as well as the percentage of caries-free individuals for both cohorts were calculated at baseline. The results are illustrated in Table 2.

Baseline caries experience of the two cohorts was compared using ANOVA test. The result of this test showed that there was no statistically significant difference in caries experience in the two cohorts at baseline ($P = 0.2$ and 0.7 for the deft and DMFT for age groups 1 and 2 respectively).

Results after 4 years

After 4 years, some of the children participating in the study were lost to follow-up mostly because they changed school. In the whole sample 5.6% ($n = 47$) of the children were lost at the last follow-up, due to changing school. The frequency distribution of children who remained in the study after 4 years is shown in Table 3.

The mean DMFT, deft as well as the percentage of caries-free individuals among children in both groups were calculated. The percentage of the change in these indices from baseline was also estimated. The results are illustrated in Table 4, which clearly shows that the caries indices (DMFT and deft) for the control group are higher than those of the study group, the same is true for the percentage of increase in these indices from baseline. The percentage of caries-free individuals decreased more in the control group, indicating that some of the children who started caries free developed carious lesions over the 4-year period of the study.

Table 1. **The frequency distribution of children in the study population at baseline**

Age group	Cohort	Male (%)	Female (%)	Total
Age group 1 (6.3 years)	Study group	102 (46.8)	116 (53.2)	218
	Control group	103 (48)	109 (51.4)	212
Age group 2 (11.7 years)	Study group	105 (48.2)	113 (51.8)	218
	Control group	102 (49)	106 (51)	208
Total		412	444	856

Table 2. **Caries experience of the study population at baseline**

Age group	Cohort	DMFT/deft* (SD)	Caries free (%)
Age group 1 (6.3 years)	Study group	4.58* (3.2)	14.7
	Control group	4.99* (3.3)	12.7
Age group 2 (11.7 years)	Study group	1.69 (1.9)	43.6
	Control group	1.70 (2.0)	42.8

DMFT, Decayed Missed Filled Teeth Index.

Table 3. **The frequency distribution of children in the study population after 4 years**

Age group	Cohort	Male (%)	Female (%)	Total	% lost
Age group 1 (6.3 years)	Study group	96 (46.4)	111 (53.6)	207	5
	Control group	98 (48.3)	105 (51.7)	203	4.2
Age group 2 (11.7 years)	Study group	101 (49.5)	103 (50.5)	204	6.4
	Control group	95 (49)	99 (51)	194	6.7
Total		390	418	808	

Table 4. **Caries indices for study and control groups after 4 years**

Age group	Cohort	DMFT/deft*		Caries free % (% change)
		Mean (SD)	% change	
Age group 1 (6.3 years)	Study group	4.6* (3.2)	+0.43	14.0 (–5)
	Control group	5.25*(3.2)	+5.2	9.4 (–25.9)
Age group 2 (11.7 years)	Study group	1.7 (1.9)	+0.59	43.6 (0)
	Control group	2.0 (1.9)	+17.6	33.0 (–22.8)

DMFT, Decayed Missed Filled Teeth Index.

The efficacy of the preventive program was tested using Pearson chi-square test, to check the association between the response to the preventive program and the two cohorts (study and control).

The results of this test showed statistically significant difference in the caries status between the study and the control groups for both ages ($P = 0.001$). The estimates of relative risk values also showed that the children in the control group are 3.1 and 6.4 times at higher risk of having dental caries than those in the study group for age groups 2 and 1 respectively.

Cochran–Mantel–Haenzele test was performed to estimate the efficacy of the program after controlling for age, gender and age and gender together. The results of this test showed highly significant difference between the two cohorts (study and control) even after controlling for the above mentioned variables ($P = 0.001$ for both age groups).

Discussion

Although it was stated that many recent international reports indicate that tooth decay was on the decline for the first time in human history (5), the situation among Jordanian school children seems to be on the other extreme (2, 3).

This calls for urgent action to start suitable preventive programs for school children in Jordan. Many recent studies reported the effectiveness of different school-based preventive programs (6–8); however, the success of such programs under the conditions prevailing in different communities needs further investigation. The present study is the first controlled study to test the efficacy of a school-based caries preventive program in Jordan.

Baseline caries experience among children in age group 1 was high (Table 2). Only 13.7% of the children in this age group were caries free. It can also be noticed that children in this age group benefited more than those in age group 2 from the preventive program. This is indicated by the relative risk estimate values which showed that children in the control group in age group 1 were more at risk (6.4 times) than those in the control group of age group 2 (3.1 times). This may be surprising, as it was proved that tooth brushing ability in children is directly proportionate with age (9). This can be explained by the fact that dental disease level was higher in this age group at baseline, so the benefit from the preventive program would be more.

The percentage of caries-free individuals still increased in age group 1 even in the study group (Table 4); this might be due to the presence of undiagnosed proximal surface lesions which have not broken the marginal ridge yet at baseline examination.

In age group 2, however, the individuals who started caries free remained so after 4 years (Table 4). This can be a sign of success of the preventive program in this population or they might just represent a group of individuals who are at low caries risk. Other factors such as the maturation of enamel, and changes in the microflora and immunological changes may play an important role in caries with increasing age.

The mean percentage of each component of the DMFT and deft indices, i.e. DT, MT, FT for permanent teeth and dt, et, ft for primary teeth at baseline and after 4 years are demonstrated in Figs 1 & 2. It can be clearly seen that at baseline (Fig. 1) the decayed component for both permanent and primary teeth was the largest among other components of the DMFT and deft indices for both groups. The missing component in the primary dentition in age group 1 is larger than the filled component; the opposite is true for the permanent dentition in age group 2. This indicates that the predominating treatment modality for carious primary teeth was extraction.

The change in these components after 4 years (Fig. 2) was in the form of reduction in the decayed component and an increase in the other components in the study group. The

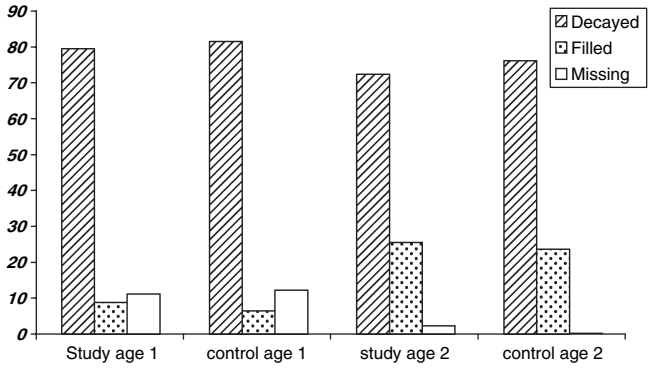

Fig 1. The percentage of the components of the Decayed Missed Filled Teeth and deft indices at baseline.

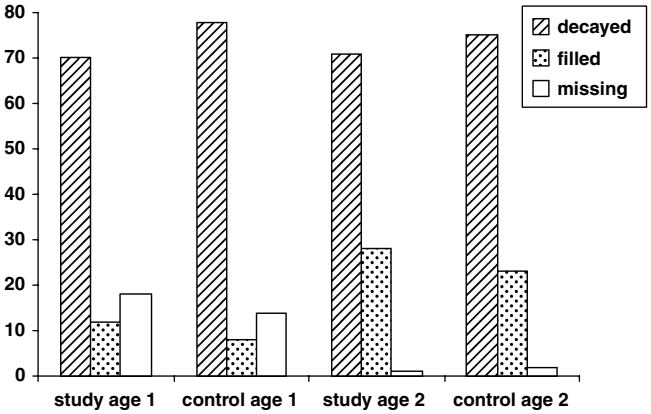

Fig 2. The percentage of the components of the Decayed Missed Filled Teeth and deft indices after 4 years.

percentage of these components did not change much in the control group. This decline in the decayed component is an important sign of an increase in dental awareness among individuals in the study group.

The preventive program outlined in this study was successful. This is indicated by the statistically significant difference between the dentition status of children in the study and control groups even after controlling for variables such as age, gender and age and gender together (CMH test). Another important indicator of success of this program is the relative risk value estimate, which indicated that children in the control group were at much higher risk of developing dental caries than those in the study group.

The results of this study are not in agreement with the classical study of Horowitz *et al.* (10), where they tested the effect of supervised daily tooth brushing on oral health in children. They found no statistically significant difference in dental or periodontal health among children in the study and control groups after three years. However, Horowitz *et al.* did not use fluoridated toothpaste in their study, which may explain the difference in the results from the current study.

School-based dental preventive programs are especially beneficial not only because they provide benefit to a large sector of the society, but also because the role of the school is important in dental health education. This is particularly because behavioural change is often easier to influence in school under the tutelage of a teacher than at home under parental guidance (11). However, it is wise to mention some of the drawbacks encountered while implementing this program. It was clear that the program demanded high levels of cooperation on the part of school administration and staff, who became increasingly uneasy as the study progressed. The teachers were also unhappy about the interruption of their school day.

The program was also expensive because of the costs of providing supplies and disposable materials such as cups, napkins, etc. as well as paying the supervising person. Appointing dental hygienists in schools in areas of high caries activity can play a major role in combating the above drawbacks and at the same time ensuring a better clinical relevance of the program, so that daily tooth brushing can become an integral part of the school day.

The European Workshop on Mechanical Plaque Control (EWMPC) recently issued a statement stressing that effective plaque removal is essential for dental and periodontal health throughout life. And that this should be reflected in the development of explicit oral health promotion policies at national and community levels (12). Although the design and the results of this study are consistent with the above, applying such program to schools in Jordan can be impractical and expensive since dental hygienists are not appointed in schools. Studies indicated that school teachers and nurses are not suitable oral health educators in schools (13), and that they should be motivated to improve their awareness on sound oral health information and attitude to facilitate their role in school oral health and preventive programs (14, 15). To involve teachers and parents in oral health education of school children, instructional sessions for these groups are mandatory (16).

To agree with the EWMPC recommendations and to get around the impracticality and expense of plaque control programs in schools, the authors suggest that dental hygienists should have a major role in applying such programs to schools so that brushing becomes an integral component rather than an interruption to the school day. They also suggest raising parents' dental awareness and teaching parents how to brush and supervise their children while brushing at home. This parental education can parallel children education at schools and can be carried out by dental hygienists during parental meeting sessions. Further studies can be carried out to test the efficacy and practicality of such parental education programs.

Acknowledgements

The author is thankful to Dr Hani Samawi, 'medical bio-statistician' for his help in statistical analysis of the results. She is also thankful to the Higher Council for Science and Technology for sponsoring the program.

References

1 Binkhor AS, Davies RM. Caries prevention. A continued need world wide. *Int Dent J* 1996; **46:** 119–25.
2 World Health Organization. *Dental Caries Levels at 12 years*. Geneva: WHO, the Oral Health Program, 1994.
3 Quteish T. Caries prevalence and periodontal treatment needs in public and private school pupils in Jordan. *Int Dent J* 1997; **47:** 100–4.
4 World Health Organization. *Oral Health Surveys, Basic Methods*, 3rd edn. Geneva: World Health Organization, 1987: 35–7.
5 Loe H. Oral hygiene in the prevention of caries and periodontal disease. *Int Dent J* 2000; **50:** 129–39.
6 Morgan MV, Campain AC, Adams GG, Crowley SJ, Wright C. The efficacy and effectiveness of a primary preventive dental program in non-fluoridated areas of Victoria – Australia. *Community Dent Health* 1998; **15:** 263–71.
7 Louw AJ, Carstens IL, Hartshorne JE, Blignaut RJ. Effectiveness of two school-based caries preventive programmes. *J Dent Assoc S Afr* 1995; **50:** 43–9.
8 Chikte UM, Lewis HA, Rudolph MJ. The effectiveness of a school-based fluoride mouthrinsing program. *J Dent Assoc S Afr* 1996; **51:** 697–700.
9 Unkel J, Fenton SJ, Hobbs G Jr, Frere CL. Tooth brushing ability related to age in children. *J Dent Child* 1995; **62:** 346–52.
10 Horowitz AM, Suomi JD, Peterson JK, Lyman BA. Effects of supervised daily dental plaque removal by children after three years. *J Public Dental Health* 1977; **37:** 180–8.
11 Harris NO, Christen AG. *Primary Preventive Dentistry*, 3rd edn. Norwalk, Cunn: Appelton and Lange, 1991: 419–37.
12 Lang NP, Attström R, Loe H. *Proceedings of the European Workshop on Mechanical Plaque Control*. Berlin: Quintessence Publishing Co. Ltd, 1998: 314.
13 Chikte UM, Brand AA, Lewis HA, Rudolph MJ. Suitability of nurses and school teachers as oral health educators in Gazannkulu – a pilot study. *J Dent Assoc S Afr* 1990; **45:** 425–7.
14 Mwangosi IE, Nyandindi U. Oral health related knowledge, behaviour, attitude and self assessed status of primary school teachers in Tanzania. *Int Dent J* 2002; **52:** 103–6.
15 Sgan-Cohen HD, Saadi S, Weissman A. Dental knowledge and attitude among Arab school teachers in northern Israel. *Int Dent J* 1999; **49:** 269–74.
16 Petersen PE, Mzee MO. Oral health profile of school children, mothers and schoolteachers in Zanzibar. *Community Dent Health* 1998; **15:** 256–62.