

A 5-year school-based comprehensive preventive program in Michigan, U.S.A.

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Abstract - The objectives were to demonstrate that a combination of preventive regimens could significantly reduce dental disease in a school population, to demonstrate the feasibility of a school-based program in relation to sustained benefits. There were 1286 students in 1st and 6th grades enrolled in the study. Subjects were stratified by grade, sex, and race and randomly placed in a treatment or education group. Procedures included ingestion of fluoridated water, oral hygiene education program, dental examinations, prophylaxis, acidulated phosphate fluoride gel (1.23%) applied in trays, pit and fissure sealants (bis-GMA) on occlusal surfaces of all eligible posterior teeth, and provision of all restorative care. Fluoride and sealant procedures were repeated at 6-month intervals. After 3 years the treatment group was randomly divided to provide a group that would not continue with treatment and serve as a comparison. The study population was enrolled in 18 schools and clinical procedures were provided on-site, using mobile dental vans. Five-year results indicate high degree of success with fall-off of benefits to those for whom treatment was terminated. This pilot program gives strong evidence for the possibility of implementing school-based dental programs. The study also indicates that prevention programs must be comprehensive and continuous for maximum benefit to occur.

Key words: dental caries; fissure sealants; fluorides.

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The increasing emphasis on attempts to prevent disease is particularly appropriate for dental diseases because of their extremely high prevalence and because dental caries and periodontal disease are largely preventable. Prevention has been emphasized recently and practical methods for reducing dental caries may be employed in the routine general practice of dentistry. Each of the individual preventive methods of water fluoridation (6), topical fluorides (7), health education (11), occlusal sealants (9), and restorative care (10) have been studied and reported singly and in some limited combinations. Few studies, however, have reported the combined effects of preventive methods that could be incorporated into routine dental practice to greatly reduce the problem of dental caries. The Askov dental project (8) conducted

during the period from 1948 through 1958 was an early study to demonstrate the effectiveness of a combination of preventive procedures. This 10-year study investigated the combined caries-preventive benefits of several methods practiced during that period which included the application of fluoride topically, supervised daily toothbrushing, dental health education, restriction of dietary carbohydrates and provision of restorative care. At the end of 10 years, the study showed reductions of 34% in DMF teeth in children aged 6-12 years and 14% in children aged 13-17 years. The children in the study, however, were not consuming fluoridated water and sealants were not available.

The study being reported here is unique in combining several preventive and therapeutic methods to significantly reduce dental caries. The

use of mobile vans to provide services on-site and the opportunity after 3 years to subdivide the treatment group allows conclusions that could not otherwise have been made. Previous reports have described the project and presented interim results (1-5).

METHODS

A description of the project and population has been published (2). The original study population comprised 1286 children enrolled in 1st and 6th grades of 18 schools in the school districts of Ypsilanti and Willow Run, Michigan. One-half of this number was randomly assigned to the treatment group, the other half to the comparison groups.

Two screening appointments were scheduled in each school year, an annual and a mid-year. At the mid-year screening, the treatment group children alone were examined to determine sealant status. No radiographs were taken at this time. Children in the treatment group were provided with a combination of five preventive methods in the order listed below:

1. An oral hygiene program in classrooms including supervised toothbrushing and flossing aided by disclosing tablets for 32 weeks in the year, and dietary counseling.
2. Dental examination followed by prophylaxis every 6 months.
3. Application of bis-GMA pit and fissure sealant (Nuvascal[®], Buonocore Method) to the occlusal surfaces of eligible posterior teeth. Sealants lost were reapplied every 6 months.
4. Topical application of acidulated phosphate fluoride in a tray for 4 min every 6 months.
5. All necessary restorative care.

Children from the comparison group necessarily consumed fluoridated water and, in addition, the oral hygiene program was also available to them.

Newly erupted teeth qualified for sealant application once the occlusal surface had penetrated the gingival tissue. At the annual screening children from both groups were examined. Bitewing radiographs were also taken. For the treatment group, sealant examination was also done followed by the treatment procedures listed above.

The application of sealant was performed according to the method of Buonocore by a licensed dentist working with dental assistants. All treatment procedures were conducted at school sites by the dentist and auxiliaries utilizing mobile dental vans. The health education program was coordinated by a dental hygienist with a background in education.

Assessments at both examinations were conducted by dental epidemiologists. Examinations were carried out under completely blind conditions. The oral condition of the mouth was judged by the number of DMF teeth and surfaces, and the calculus, debris, and periodontal index scores. Criteria used to assess dental caries were those developed at the 1968 ADA Conference on the clinical testing of cariostatic agents (12).

At the end of 3 years the treatment group was randomly divided to provide a group that would not continue with treatment and serve as a comparison. After 5 years the conclusion of the study observed three groups; the treatment

group that received the complete program for 5 years, a treatment comparison group that received the complete program for 3 years and discontinued for 2 years, and a comparison group that did not receive any treatment other than the oral hygiene program for 5 years.

PARTICIPATION AND ACCEPTANCE

A total of 1286 students in the 1st and 6th grades volunteered to participate in the study. This represented 85% of the students at the respective grade levels in attendance at the elementary schools in the optimally fluoridated area serviced by the city of Ypsilanti. Of this group, 698 were in the 1st grade and 589 were in the 6th grade when the study began. A baseline screening which included bitewing radiographs was done for all the children. Afterwards, the entire group was stratified on the basis of grade, sex and race. Each stratum was then shuffled and dealt out into two stacks, one of which was subsequently arbitrarily labeled "treatment group" and the other "control group". Adjustments were then made to assure that children from the same family would not be in different groups. If one child in a family was in the treatment group, any other children from the same family were also placed in the treatment group. This resulted in a treatment group of 650 students (349, 1st grade; 301, 6th grade) and a control group of 636 (349, 1st grade and 287, 6th grade). Fifty-one percent of the students were still active participants in the study when it terminated after 5 years. This figure is derived from 333 in the treatment group (193, 1st grade group; 140, 6th grade group) plus 329 in the control group (199, 1st grade group; 130, 6th grade group).

Subject loss averaged out to be 9.7% per year. Participation in the program was quite high when considering normal attrition and other factors such as the initiation of a major auto union dental insurance plan during the study for most families in the program.

COSTS

Treatment facilities for the study were two mobile dental vans equipped with two operatories each. The vans were purchased and fully equipped for a total cost of \$75 000. The 5-year cost of operating the 2 mobile vans was \$13 727. This represents a facility cost of \$18 per year per student involved in the project. By including personnel and other costs, the total cost per student was \$146.58 per year. These figures do not account for the positive effects in addition to caries reductions of the program being present in the school system. Areas that have not been measured but can be considered influential are in-service workshops for teachers, dental health education materials from the project utilized by other classes, peer pressure to improve oral health, and general increased oral health awareness as a result of dental activities surrounding this project. These figures also do not reflect the reduction in costs that would occur over a longer period due to lower equipment costs since the mobile vans are still quite serviceable and were not amortized.

RESULTS

Group 1 is the treatment group that received all procedures from the initiation of the project. Group 2 received all procedures for 3 years and then only annual exams similar to group 3, the original comparison group. The mean DMFS increment from baseline to 5th year for 1st graders in treatment group 1 was 1.22; for the treatment/comparison group 2 it was 1.46, and 2.28 for the comparison group. Corresponding figures for 6th graders were 1.77, 3.26 and 4.46 (Tables 1 and 2). Treatment group 1 had the smallest increment

Table 1. Five-year DMFS increment in first grade children, Ypsilanti, Michigan 1973-1978

Group	n	Baseline exam		Increment from baseline to fifth year	
		Mean	s.d.	Mean	s.d.
Treatment 1	96	0.4896	1.2481	1.2188	1.6809
Treatment 2	97	0.2371	0.7184	1.4639	1.9314
Comparison	199	0.3317	1.0252	2.2814	2.6745

Table 2. Five-year DMFS increment in sixth grade children, Ypsilanti, Michigan, 1973-1978

Group	n	Baseline exam		Increment from baseline to fifth year	
		Mean	s.d.	Mean	s.d.
Treatment 1	78	4.7564	4.7130	1.7692	3.4488
Treatment 2	62	5.3065	4.2948	3.2581	3.9461
Comparison	130	5.3308	4.7355	4.4615	4.8913

followed by treatment group 2 and the highest increment for the comparison group. The difference in increment between the comparison group and each of the two treatment groups was statistically significant ($P < 0.05$). The analysis of the caries increment by surface type showed a significant difference in occlusal increment between each of the treatment groups 1 and 2 and the comparison group. Occlusal increment for 1st grade children in group 1 was 0.75; for group 2 was 0.96; and for comparison was 1.38 (Table 3). Corresponding figures for 6th graders were 0.81, 1.66 and 2.29 (Table 4). All of the study children consumed fluoridated water which would make smooth surface reductions in all three groups similar. The mesiodistal increment, therefore, was essentially similar in all of the children. From a clinical standpoint, smooth surface increments for older children followed an interesting pattern. The lowest increment was for treatment group 1 followed by group 2 with the highest increment in the comparison group. This clinical difference could be attributed to the effect of topical fluoride applications.

The combined treatment procedures which were continued for treatment group 1 reduced the dental caries increment by 64% in older children and by 40% in younger children. The percent reductions in caries increment for children from treatment group 2 which had treatment discontinued after 3 years were not as high. The reductions were 29% for older children and 24% for younger children. The oc-

Table 3. Five-year DMFS increment by surface type in first grade children, Ypsilanti, Michigan, 1973-1978

Group	n	Buccolingual increment		Mesiodistal increment		Occlusal increment	
		Mean	s.d.	Mean	s.d.	Mean	s.d.
Treatment 1	96	0.2813	0.7498	0.1875	0.5091	0.7500	1.0157
Treatment 2	97	0.3402	0.8647	0.1649	0.5140	0.9588	1.2325
Comparison	199	0.6935	1.2109	0.2111	0.6858	1.3769	1.4886

Table 4. Five-year DMFS increment by surface type in sixth grade children, Ypsilanti, Michigan 1973-1978

Group	n	Buccolingual increment		Mesiodistal increment		Occlusal increment	
		Mean	s.d.	Mean	s.d.	Mean	s.d.
Treatment 1	78	0.1795	1.4392	0.7821	1.8632	0.8077	1.3198
Treatment 2	62	0.5645	1.2883	1.0323	1.8374	1.6613	1.8900
Comparison	130	0.6935	1.2109	1.5231	2.8725	2.2846	2.2661

clusal surface reductions followed the same pattern with the lowest increments for those children who continued to receive the complete preventive treatment program. These caries reductions are in addition to the benefits of water fluoridation.

DISCUSSION

The success of the program in regard to caries reductions is interesting in light of the fact that difficulties occurred which could have biased the results in a negative direction. For example, during the study, several treatment group children were seen by local practitioners who placed restorations in many teeth which had received sealant. This community also became eligible for dental benefits through the auto union's insurance plans allowing several study children to be treated by private dentists. These factors would diminish the actual caries reductions determined for the study children. During the 4th and 5th year of the project, the format of the groups allowed for interesting comparisons to be made demonstrating that caries preventive procedures must be continuous for maximum benefit to be gained. The group that received all of the procedures for 3 years and then nothing for 2 years had a drop off in benefit as compared to the group that received all of the procedures for 5 years.

The results showed that treatment group 1 received the maximum benefit from the program in contrast to group 2 which had treatment discontinued after 3 years. The resulting 2 years of not participating in the preventive program is reflected in higher increments of caries. This study has provided significant information to indicate that a preventive program should be continuous and not just limited to a few select years. Caries reductions could not be sustained in the group that had received the program for 3 years and then not continued. For children who continued in group 1 which received the entire program for 5 years, there was a consistent and sustained reduction in dental caries in addition to the benefits of water fluoridation. Preventive programs therefore cannot be thought of as limited or preferential in terms of the children they serve. The programs should be well planned to consider the effects of possible termination of treatment and what measures would be

necessary to insure continued caries reductions. For this study, a comprehensive school-based preventive program has been able to demonstrate that for a specific child population dental caries could be essentially prevented. The program was well accepted by parents and children, provided quality care at a reasonable cost and, most importantly, reduced dental disease.

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