Evaluation of Pacific Islands Early Childhood Caries Prevention Project: Republic of the Marshall Islands

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Abstract

Objectives: *This communication reports an outcomes evaluation of the Pacific Islands Early Childhood Caries Prevention Project.* ***Methods:*** *The evaluation includes children in three conditions: a) topical fluoride varnish three times per school year; b) varnish plus twice-per-day toothbrushing; and c) intervention 2 plus three-times-per-day xylitol containing gummy bear snacks at school and home visits to encourage parental involvement. For this evaluation, groups 2 and 3 have been combined.* ***Results:*** *One year after project implementation, mean decayed, extracted, or filled primary teeth was 10.3 [standard deviation (SD) = 4.3] teeth for group 1, and 8.2 (SD = 4.0) teeth for the combination of groups 2 and 3 (*$P < 0.05$*). Twenty-four percent of group 1 had cavitated lesions in any permanent molar versus 12.8 percent in groups 2 and 3 combined (*$P > 0.05$*).* ***Conclusion:*** *Evaluation confirms the outcome of a program including both in-school twice-daily toothbrushing with fluoridated toothpaste and frequent applications of fluoride varnish.*

Key Words: outcomes evaluation, oral health, fluoride, fluoride varnish, fluoridated toothpaste, children, early childhood caries

Introduction

While Tomar (1) has argued for evaluation as part of the planning and conduct of community oral health programs, it is unusual to find comprehensive evaluations in the dental literature. A systematic review of the clinical outcomes of community programs to address early childhood caries published in 2007 could find only 19 among 916 articles in the world literature since 1966 in which sufficient data were available for inclusion (2). Although the final analysis was confined to studies in which participants were randomly assigned and there was insufficient data for a meta-analysis, the authors concluded that fluoride-based interventions were most likely to be effective. This is consistent with reviews of efficacy studies (3). A great many school-based intervention programs have been successfully carried out (4). The purpose of this article was to describe the evaluation for a Head Start–sponsored community program to reduce tooth decay in young children.

Methods

Design of the Outcomes Evaluation. The outcomes evaluation includes children in three conditions: a) three-times-per-school-year topical fluoride varnish alone. Tooth brushes and fluoridated toothpaste were sent home once every 3 months; b) varnish plus twice-per-day supervised toothbrushing with fluoridated toothpaste at school; and c) intervention 2 plus three-times-per-day consumption of xylitol containing gummy bear snacks at school and home visits to encourage parental involvement. For the purposes of this outcomes evaluation, groups 2 and 3 had been combined because the number of children in each group was relatively small. The data for the evaluation were collected in the 2007-2008 school year. De-identified data were provided to the evaluators.

Setting. The outcomes evaluation was conducted on Majuro atoll in the Republic of the Marshall Islands (RMI). The Ministry of Health (MOH) was a participant in the Pacific Islands Early Childhood Caries Prevention Project sponsored by the Office of Head Start. Since the initiation of this project, the RMI government has converted Head Start centers into kindergartens. Early childhood caries is a serious health-care problem in the RMI. The average child entering Early Childhood Education programs has 6.8 untreated decayed teeth, and over 90 percent have at least one decayed primary or permanent tooth. Fifty-one percent of 2-year-olds have at least one decayed primary tooth (5). The MOH operates a dental clinic at the Majuro Hospital. There are no private dentists and no fluoridated water.

Participants. There were 473 children in the program: 360 were part of group 1, and 113 were in groups 2 and 3. The average age of the children at the start of the program was 64 [standard deviation (SD) = 6] months. Parents gave their permission for the children to be part of the program. Special educational materials designed for populations with low health literacy were used to inform parents.

Assignment to Interventions. Every child within a particular school received the same intervention. Assignment of schools to an intervention was not random and was based on the availability of running water at the school site.

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Interventions

Preventive assistants. Six recent high school graduates and two previously hired dental assistants were selected for training and employment in the prevention program. Requirements were graduation from high school, good speaking and writing ability in English, reliable previous work or school record with demonstrated responsibility and ability to work accurately, positive attitude, and professional manner in working with others.

A 3.5-month locally appropriate training program was developed (6). The objective of the training was to prepare graduates for work both in the clinic and in preventive programs in the community. Content included an orientation to professional demeanor and comportment; teamwork; basic medical sciences such as basic head and neck anatomy, physiology, and pharmacology (4 hours each); medical emergencies including CPR training (4 hours); oral anatomy and the dentition and tooth morphology (8 hours); dental disease etiology, prevention, and pathology with a focus on caries and periodontal disease (8 hours); infection control (2 hours); sterilization and maintenance of dental instruments and equipment (2 hours); dental materials, dental radiology and radiation hygiene, and laboratory procedures (e.g., pouring models, 4 hours). Each student received chair side training as well as clinical training in the application of topical fluoride varnish, uncomplicated prophylaxis, and supragingival scaling, and both chemical- and light-cured occlusal sealants. Students received training in oral health education in the community.

Fluoride varnish. Varnish (Cavity Shield, OMNII Oral Pharmaceuticals, West Palm Beach, FL) was applied at 3-month intervals during the school year. The children were seated in a portable dental chair or placed on a mat on the classroom floor, with each child's head on the lap of the assistant and the mother assisting. The teeth were wiped with cotton gauze, and the varnish was applied by using a disposable brush. The parent was asked not to allow the child to eat or brush his or her teeth for 1 hour.

Fluoridated toothpaste. The children were given toothbrushes (Oral B, 2-4 years, Iowa City, IA) and fluoridated toothpaste (Dinosaur Fluoride toothpaste, Sheffield Laboratories, New London, CT). At the beginning of the year, the children received instruction in toothbrushing by a preventive assistant and then were supervised in brushing by teachers. Each child had his or her own toothpaste. Teachers were instructed to place pea-sized amount of toothpaste on each child's brush. The children also were given toothbrushes and paste for home brushing.

Xylitol gummy-bear snacks. The children were given nine xylitol gummy-bear snacks at school for a daily dose of 11.7 g. Danisco (Redhill, UK) provided the formula and Santa Cruz Nutritionals (Santa Cruz, CA) manufactured the gummy bears.

Clinical Examinations and Measures. Children were examined clinically by a single trained examiner at the beginning and end of the school year. The primary clinical evaluation outcomes of the study are the number of decayed, extracted, or filled primary teeth (deft) and the number of decayed first permanent molars (D) defined as a cavitated tooth. A single dentist examiner (OT) was trained to the World Health Organization diagnostic protocol and examined the teeth visually using a disposable dental mirror and an artificial light. Compared with a gold standard examiner (PM), the examiner demonstrated excellent reliability for caries diagnosis (interrater correlation coefficient of 1.00 and 0.96 at two different points in time).

Statistical Analysis. The data were cleaned and entered into SPSS Version 16 (Release 16.0.1, SPSS Inc., Chicago, IL, USA) for Mac OS. The outcome in deciduous teeth (def teeth) was assessed, comparing the two intervention conditions using a *t*-test. To assess the outcome in the permanent molars, the D component of the WHO assessment scheme was dichotomized as either cavitated (score 1) or healthy (score 2), and the differences between the groups were evaluated by using logistic regression, with and without adjustment for baseline deft.

Results

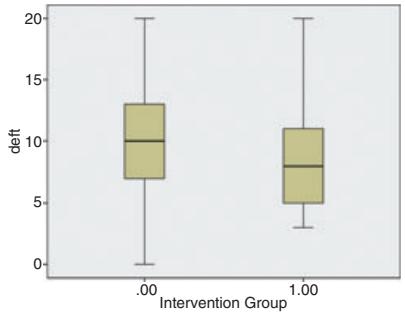
Participation. There were 473 children enrolled at the beginning of the year, and 421 (89 percent) completed the outcomes evaluation [328 in group 1 (6 schools) and 93 in the combination of groups 2 and 3 (2 schools)]. The follow-up rate was 91 percent for group 1 and 82 percent for groups 1 and 2 combined.

Initial Caries Level. The overall deft at the beginning of the intervention program was 8.51 (SD = 4.3) teeth. The mean deft was 8.3 (SD = 4.3) teeth for group 1 and 7.9 (SD = 4.4) teeth for the combination of groups 2 and 3, and they were not different (T = 0.685, $P = 0.49$). Eighty-one percent of the children had no decay in their first permanent molars at the start of the year, and there was no difference in the number of decayed permanent molar teeth between the groups (T = 1.68, $P = 0.093$).

Evaluation Outcome by Group. One year after program implementation, mean deft was 10.3 (SD = 4.3) teeth for group 1, and 8.2 (SD = 4.0) teeth for the combination of groups 2 and 3 (T = −2.86, $P = 0.004$). Figure 1 illustrates the difference between the outcomes (median scores) using box plots of the deft by group.

A total of 24 percent of the children in group 1 had cavitated lesions in any permanent molar compared with 12.8 percent of the children in groups 2 and 3 combined [B = −0.769, standard error = 0.496, 95 percent confidence interval for Exp(B) 0.75, 1.22]. Although the difference is not statistically significant, the clinical difference is large. The children in groups 2 and 3 who received the treatments were at least half as likely to have developed cavities as the children who received the less intensive treatment. Adjustment for baseline deft and age at the

Figure 1
Median def teeth score and quartiles 1 year after program implementation for children in group 1 (left plot, *n* = 328) who received fluoride varnish at school and toothbrushes and toothpaste to take home, and for children in groups 2 and 3 combined (right plot, *n* = 93) who received fluoride varnish once every 3 months and toothbrushing in school with fluoridated toothpaste twice daily. deft, decayed, extracted, or filled primary teeth



start of the program in a separate regression analysis did not improve the prediction. The difference was essentially the same when D teeth were compared by using parametric statistics.

Discussion

We conducted an evaluation of the outcomes of the Pacific Islands Early Childhood Caries Prevention Project site in the RMI in cooperation with the dental department of the MOH. Other island sites were in the Republic of Palau, Pohnpei, Chuuk and Kosrae states of the Federated States of Micronesia, and Guam. The project was conducted under an initiative of the Office of Head Start in response to growing levels of tooth decay in preschoolers in the United States and Pacific territories and affiliated states, most of which are untreated (6,7).

Although the level of tooth decay, even with preventive efforts, is several times greater than the average in the mainland United States, the level is not unusual for many communities served by Head Start. We have argued elsewhere that Head Start delegate agencies need to adopt a more public health approach to preventing and arresting tooth decay rather than expending enormous amounts of resources to try to obtain curative treatment for a few, while most children do not receive the basic preventive interventions that have been demonstrated to be effective in this evaluation (7). One of the lessons learned is the importance of strong collaborative relationships between public health dental departments and the schools. Without dental leadership, educators and health coordinators are left unsure of how to alter the course of this disease. The work also demonstrates that paraprofessional assistants and teachers can deliver by the key interventive services (6). A more extensive program along the same lines with similar results was recently reported (8).

One limitation of an evaluation such as this, in contrast to formal trials, is that children and classrooms or schools were not randomly assigned. Nevertheless, there was no difference in the initial def teeth scores or decayed first permanent molars for the two groups compared, and the final differences are clinically impressive. Evaluations of similar work by others should add to our knowledge in the future.

This work demonstrates and suggests that topical fluoride treatments alone may be insufficient to arrest the disease process in high-risk populations. At a minimum, twice-daily toothbrushing with fluoridated toothpaste is needed in addition. Because of the small size of the more intensive treatment groups, we were not able to assess the effect of added home visits and xylitol snacks, but this effect should be additive. Other work has demonstrated the potential effectiveness of both as well as a xylitol topical syrup (9-11).

Conclusion

The outcomes evaluation of the Pacific Islands Early Childhood Caries Prevention Project confirms the effectiveness of a program including both in-school twice-daily toothbrushing with fluoridated toothpaste and frequent applications of fluoride varnish.

Acknowledgments

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