

Caries-preventive effects of daily and weekly fluoride mouthrinsing in an optimally fluoridated community: findings after eighteen months

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Abstract

Two groups of children, beginning in the seventh grade, rinsed their mouths at school either once a week with a 0.2 percent solution of neutral sodium fluoride or once a day with a 0.05 percent neutral sodium fluoride solution. A control group of children followed the procedure once a week using a placebo mouthrinse. Results after 18 months showed that both fluoride mouthrinse procedures effectively reduced the incidence of dental caries. The reductions in caries were in addition to those already accrued from consuming optimally fluoridated drinking water.

Introduction

It has been amply demonstrated that the prevalence of dental caries can be reduced by 50 to 65 percent in communities if residents consume optimally fluoridated water from birth. Although water fluoridation is highly effective in reducing the prevalence of dental caries, additional measures should be developed to prevent the dental decay that remains despite fluoridation. Rinsing in school with a fluoride solution is a logical choice for investigation, because it is simple to carry out and is inexpensive.

School-based fluoride mouthrinsing programs have been increasingly used for caries prevention during the past ten years in communities where the water is fluoride-deficient. Two regimens in particular have proved effective in numerous clinical trials: a 0.05 percent sodium fluoride (NaF) rinse (0.023%F) used daily or on school days, and a 0.2 percent NaF rinse (0.09%F) used weekly or fortnightly.¹⁴ Nearly all fluoride mouthrinsing studies reported to date have been carried out in communities in which the public water supply lacked fluoride. A few studies conducted in fluoridated areas, however, have shown fluoride mouthrinsing to be effective in those locations,^{5,7} but further evidence is needed to determine its value. There is some clinical evidence indicating that the degree of caries protec-

tion resulting from the use of fluoride solutions may be more dependent on the frequency of use than on the concentration of fluoride in the solution;^{8,10} however, this observation requires further support. Additional investigations are thus needed to determine the comparative effectiveness of the daily and weekly mouthrinsing procedures, both in fluoridated and non-fluoridated areas.

The purpose of this study is to determine whether fluoride mouthrinsing in school provides additional caries protection to the teeth of children who reside in an optimally fluoridated community and to compare the caries-preventive effects of daily and weekly in-school fluoride mouthrinsing in these children.

The study will last 30 months; this paper presents interim findings after 18 months of investigation.

Methods and Materials

The study began in November 1977 with 966 seventh-grade children (mean age 12.8 years) in nine junior high schools in the city of Des Moines, Iowa, where the water supply has been fluoridated since September 1959. Analytical records indicate that the average fluoride concentration maintained in the drinking water from 1964 through 1979, a period which covers the lifetime of the study participants, was 0.84 ppm. Although this figure is below the recommended optimal concentration of 1.0 ppm fluoride for the geographic area, it is above the lower control limit for that optimal level, according to standards for water fluoridation established by the Public Health Service.¹¹

Children were not excluded from participation on the basis of their residence history because mobility is common, particularly in urban areas. Findings based only on lifetime residents would be less applicable to populations as they actually exist in most other fluoridated areas.

dated cities in the United States. Residence histories were collected, however, and the data show that 67 percent of those children present for the 18-month evaluation were lifetime residents, an additional 17 percent had been residents at least since first grade, and only 16 percent had moved to Des Moines at some point after first grade. It is possible, of course, that many of the non-lifetime residents had lived in other optimally fluoridated communities before moving to Des Moines.

Two Public Health Service dentists (W.S.D. and P.A.S.) made the baseline dental examinations. At baseline, each child was assigned randomly to one of the two examiners, who used the DMF surface index for recording dental caries. The examiners used plane dental mirrors, explorers and artificial light; radiographs were not taken.

Treatment procedures were initiated to coincide with baseline dental examinations. The children were assigned randomly, within each study school, to one of the following three groups: those in group C (controls) rinsed their mouths once every week in school with 10 ml of a placebo solution containing 0.1 percent sodium chloride; those in group W rinsed their mouths once every week in school with 10 ml of a 0.2 percent NaF solution; and children in group D rinsed their mouths once every day in school with 10 ml of a 0.05 percent NaF solution. All mouthrinse solutions were unsweetened, unflavored and colorless. Rinsing was carried out in the classroom under the teacher's supervision and was timed for a period of one minute. Since each classroom usually contained children from all three study groups, the teachers were carefully instructed to ensure that members of each group received their appropriate mouthrinse. Fresh mouthrinse was prepared at each school each week and delivered to the participating classrooms in color-coded dispensers.

Each study year, prior to the initiation of mouthrinsing, training sessions were held for teachers who would be supervising the procedure. Project personnel also visited every classroom on the first day of treatments each year to help the teachers and students implement the procedures. A local dental health educator was employed part-time to coordinate the project and to periodically monitor the treatment procedures in the classrooms. In order to provide more frequent classroom monitoring and to sustain the cooperation of the students and teachers, three additional persons with backgrounds in dental hygiene were hired part-time to assist during the second study year.

During the 18 months covered by this report, participants in the weekly rinsing groups could have rinsed as many as 50 times and those in the daily group as many as 250 times. According to records maintained by the classroom teachers, only a few chil-

Table 1. Mean number of DMF surfaces at baseline by study group for children examined initially and for those remaining after 18 months.

Study Group	No. of Children	Mean No. DMF Surfaces
Children Examined Initially		
C (controls)	284	5.30 (4.80)*
W (weekly)	298	4.81 (4.39)
D (daily)	384	4.84 (5.24)
All Groups	966	—
Children Remaining After 18 Months		
C (controls)	177	5.22 (4.54)
W (weekly)	189	4.78 (4.51)
D (daily)	235	4.83 (5.61)
All Groups	601	—

*Figures in parentheses are standard deviations.

dren examined after 18 months missed more than 20 percent of the assigned treatments, and therefore, no attempt was made to exclude inadequately exposed participants from the analysis.

Follow-up examinations to determine dental caries increment were conducted in April 1979, 18 months after treatments were initiated. Each child was re-examined by the same dentist who made the baseline examination. The examiners were unaware of any child's group assignment, and did not have access to records from the baseline examination.

Results

Table 1 presents two sets of mean baseline DMF surface scores. The first set consists of baseline scores by group for all children examined initially, and the second set contains the same information for those who remained in the study after 18 months. It is apparent from a comparison of the two data sets that the loss of children from the study during the 18-month period had practically no effect on the initial caries scores of the three groups. The two data sets also demonstrate that the three study groups are homogeneous with regard to their baseline caries scores. Although the mean scores for Groups W and D are lower than those of Group C, the differences are small and are not statistically significant ($p=0.39$ for children examined initially and 0.65 for children remaining after 18 months).

Group D, the daily rinse group, was initially assigned about one-third more children than either of the two weekly groups to compensate for an anticipated higher drop-out rate because of the more demanding nature of the daily regimen. However, this premise was not substantiated, as evidenced by the number of children remaining after 18 months. The attrition rate for the total study population was 37.8 percent, and the percentage loss was almost equally distributed among the three study groups. Treatment

Table 2. Mean incremental DMF surface scores by study group after 18 months.	Study Group	No. of Children	Mean DMFS Increment	% Difference from Control	P Value
	C (controls)	177	1.76 (3.16)*	—	—
W (weekly)	189	1.22 (2.55)	30.7	0.03	
D (daily)	235	1.06 (2.54)	39.8	0.01	

*Figures in parentheses are standard deviations.

records indicated that the loss of subjects was due primarily to children moving out of the Des Moines area or to non-participating schools within the area, and to voluntary withdrawal at the request of the child or the child's parents. These two factors contributed about equally to the loss of participants.

Table 2 shows mean incremental DMF surface scores after 18 months for each of the study groups. The data represent findings for both examiners combined since a two-way analysis of variance revealed no significant differences in treatment effects by examiner. Children in group W, who used the weekly fluoride mouthrinse, experienced an average of 0.54, or 30.7 percent, fewer DMF surfaces than children in group C, who served as controls. Participants in the daily fluoride mouthrinsing group (group D) showed 0.70, or 39.8 percent, fewer DMF surfaces than their counterparts in the control group. The differences in incremental scores among study groups were tested statistically using the Bonferroni t-statistic, as presented by Miller.¹² One-tailed probability (p) values, shown in the last column of Table 2, indicate that the difference in scores between the controls and both treatment groups are statistically significant. The difference in scores between the two treatment groups, however, was not statistically significant. The incremental data were also subjected to an analysis of covariance, using baseline DMF surface scores as the covariate. This analytical procedure produced the same results as did the Bonferroni t-statistic, with only trivial adjustments being made to the treatment group means.

Table 3 shows findings according to type of tooth surface, that is, occlusal, mesiodistal and buccolingual. Compared with the controls, both treatment groups showed lower mean incremental scores for all three types of surfaces. The largest absolute differences in

increment between the control and treatment groups occurred on the occlusal and buccolingual surfaces, which are the surfaces that accounted for most of the caries increment in the three study groups during the 18-month period. The scores in the daily group were lower than those in the weekly group for mesiodistal and buccolingual surfaces, while the scores for the two treatment groups were almost identical for occlusal surfaces. However, for all three types of surfaces, the absolute differences in scores between the two treatment groups were quite small.

Discussion

These findings demonstrate that weekly and daily fluoride mouthrinsing (in school for 18 months) both provide significant caries-preventive benefits beyond those already accrued from consuming optimally fluoridated drinking water. Both procedures appear to be effective in reducing dental caries incidence on all tooth surfaces, although the exceedingly small increment occurring during the 18-month period on mesiodistal surfaces provided only a limited opportunity to demonstrate a cariostatic effect on these surfaces. Assessment of the effects on mesiodistal surfaces may be enhanced at the time of final examinations when the children are older and there has been more time for caries to develop in these surfaces.

The percentage reductions in dental caries found in Des Moines are similar to those reported in two previously conducted studies of fluoride mouthrinsing in fluoridated areas.^{5,6} In one of these studies, Radike and coworkers⁵ evaluated daily mouthrinsing in school with a 0.1 percent stannous fluoride solution (0.025%F). After 20 months, two examiners independently observed respective differences of 33 and 43 percent in incremental DMF surfaces, compared with a control group that used a placebo rinse. The other

Table 3. Mean incremental DMF surface scores by type of surface and study group after 18 months.	Study Group	Type of Surface		
		Occlusal Increment per Child	Mesiodistal Increment per Child	Buccolingual Increment per Child
C (controls)	1.06	0.23	0.47	
W (weekly)	0.75	0.18	0.29	
D (daily)	0.78	0.14	0.14	

study was carried out in Sweden by Hagglund.⁶ Although details of the study design and treatment procedures were not reported, the study involved rinsing once a week with a neutral sodium fluoride solution of the same concentration as that used for the weekly procedure in Des Moines (0.2% NaF). An evaluation of the procedure after five years showed a 30 percent reduction in dental caries for children who used the fluoride rinse.

Laswell, et al.⁷ have also reported the results of a school-based study of daily and weekly fluoride mouthrinsing in a fluoridated community. In their study, an acidulated phosphate-fluoride rinse was used at fluoride concentrations of 200 ppm for the daily regimen and 1000 ppm for the weekly regimen. After 28 months of study, the weekly rinse group showed a 46 percent reduction in DMFS increment, compared with the controls. Surprisingly, the daily regimen resulted in a much smaller reduction in caries of 23 percent, which was not statistically significant. The authors did not attempt to explain the relative lack of effectiveness of the daily rinse.

Interestingly, the relative caries-preventive benefits found in Des Moines and in the aforementioned studies by Hagglund and by Radike and coworkers are similar to those found in several other investigations of daily or weekly rinsing with sodium fluoride solutions in non-fluoridated areas.¹⁴ In contrast, percentage reductions in caries reported for certain other fluoride procedures in fluoridated areas have generally been smaller than those reported for the same procedures in non-fluoridated areas.¹³ The achievement of at least comparable relative effectiveness in a fluoridated area is important from a standpoint of cost-effectiveness, because the potential number of tooth surfaces that can be protected from decay by use of the procedure has already been reduced by about 50 to 65 percent as a result of fluoridation. This factor alone greatly reduces the cost-effectiveness of any supplemental procedure. If a supplemental procedure also proves to be less cariostatic in a fluoridated area, then cost-effectiveness is reduced even further.

A major advantage of fluoride mouthrinsing compared with many other caries-preventive regimens is its low cost — if facilities and personnel are provided gratis and the only costs incurred are those for the rinse materials. However, the total costs of materials for weekly and daily mouthrinsing differ considerably; the weekly procedure has been estimated to cost about 50 cents per child per school year,¹³ whereas the daily procedure costs about four times that amount.¹⁴ Therefore, the daily procedure would have to produce greater cariostatic benefit to be as cost-effective as the weekly procedure. The findings in Des Moines did not, however, indicate greater effectiveness for the daily group. Although the percentage reduction was higher

for the daily group than for the weekly group, the actual difference in caries increments between the groups was too small to be either statistically or clinically significant. In addition to the factors of cost and effectiveness, considerably more school time and effort are needed to carry out daily rinsing than weekly rinsing. Daily mouthrinsing would have to be markedly more effective than weekly rinsing before it could be promoted for use in school-based programs.

Conclusion

Findings after 18 months indicate that both daily and weekly mouthrinsing with fluoride solutions in school imparted significant caries-preventive benefits. The observed benefits were in addition to those realized by the children from consumption of optimally fluoridated drinking water. The findings did not show the daily procedure to be significantly more beneficial than the weekly procedure. At the time of final examinations, the participants will have completed one additional year of rinsing and will have had more time to demonstrate the efficacy of the procedures on all types of tooth surfaces. Information from the final examinations should provide further insight into the relative benefits of daily and weekly rinsing.

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Istanbul Bird Lady, 1975

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