

Effect on the primary dentition of mouthrinsing with a 0.2 percent neutral NaF solution: results from a demonstration program after three school years*

Louis W. Ripa, D.D.S., M.S.
Gary S. Leske, D.D.S., M.S., M.P.H.

Louis W. Ripa is Professor and Chairman, Department of Children's Dentistry, School of Dental Medicine, State University of New York at Stony Brook, Stony Brook, Long Island, NY.

Gary S. Leske is Associate Professor, Department of Children's Dentistry, and Assistant Dean for Curriculum and Student Affairs, School of Dental Medicine, State University of New York at Stony Brook, Stony Brook, Long Island, NY.

Requests for reprints may be sent to Louis W. Ripa, Department of Children's Dentistry, School of Dental Medicine, State University of New York at Stony Brook, Stony Brook, NY 11794.

Accepted: April 8, 1980

* This investigation was supported, in part, by Grant #NO1-DE-52460 from the National Institute of Dental Research, National Institutes of Health, Bethesda, Maryland.

Abstract

Benefits are presented for primary teeth from a school-based weekly fluoride rinsing program using a neutral 0.2 percent NaF solution in a fluoride-deficient community. Children in grades three and four at the time of the last dental examination rinsed an average of 77 times during three school years. Rinsing was done under the supervision of classroom teachers. Compared with baseline caries scores of children in the same community who never rinsed, there was a reduction in caries prevalence after three years of 17.6 percent (dfs/child) or 17.3 percent (dfs/100s). The greatest reduction after three years (24.2 percent) was found for proximal surfaces. The magnitude of caries reduction for the permanent dentition increased after each year of rinsing, but an increased reduction for the primary dentition was not observed between the second and third rinsing years.

Introduction

In 1975, the Council on Dental Therapeutics of the American Dental Association stated that both neutral sodium fluoride and acidulated phosphate-fluoride rinses were "effective agents for use in reducing the incidence of dental caries."¹ The conclusion of the Council was based upon a review of 19 clinical trials in which the effect of mouthrinsing on the permanent teeth was assessed. No trials of the effect of mouthrinsing on the primary dentition were included

in the Council's review. This is not surprising since, at that time, no such reports were available.

In the same year, the National Institute of Dental Research sponsored 17 demonstration programs throughout the United States and possessions in which approximately 80,000 school children were to rinse once a week with a neutral 0.2 percent sodium fluoride (NaF) solution. As part of this national program, weekly fluoride rinsing was instituted in the Three Village Central School District, Long Island, New York. Since children in the kindergarten through sixth grade were participants of the program, an opportunity was afforded to assess the impact of fluoride rinsing on primary teeth. After two years, a 20.0 percent reduction in caries prevalence (dfs/child) of the primary teeth was reported.²

This report presents the effect on caries prevalence in the primary dentition after three school years of rinsing. Data showing the effects of the rinsing program on the permanent dentitions are included for comparison.

Methods and Materials

The rinsing program is conducted in six elementary schools, which are located in adjoining fluoride-deficient ($F = 0.1$ ppm) communities.

Program Enrollment

In September, 1975, consent forms were distributed to the parents of approximately 6,000 students in the kindergarten through sixth grades. An affirmative response was received from 4,535 children, representing a participation rate of 76.5 percent.

Each year, new kindergarten children who return properly signed consent forms are enrolled in the rinsing program, while seventh grade children, who graduate to the junior high schools, are withdrawn. While the percentage participation has increased each year, the actual number of participants has decreased due to a decline in the total school population. Currently, approximately 4,000 children participate in the rinsing program.

Rinsing Program

Rinsing is conducted once a week with a 0.2 percent neutral sodium fluoride (NaF) solution.* Kindergarten-

* Premeasured packets of NaF, plastic containers, calibrated pumps, and paper products are purchased from Medical Products Laboratories, Philadelphia, Pennsylvania.

ten children rinse with 5 ml, all others with 10 ml. Project personnel mix the NaF solution and distribute it to approximately 240 classrooms. The rinsing is supervised by the classroom teachers who instruct the children to rinse the solution for 60 seconds before expectorating it into disposable paper cups. The rinsing program has been described in other publications.²⁻⁵

Because of the time necessary to initiate the program, including the recruitment of participants, hiring of personnel, and ordering supplies, rinsing did not start immediately with the academic year. Thus, the average participant rinsed 19 times during the first year, 30 times the second year, and 28 times the third year.

Dental Examinations

In the beginning of each academic year, 125 children were randomly selected from each grade level and received a mirror and explorer examination for dental caries. The criteria used were those recommended by the American Dental Association's Conference on the Clinical Testing of Cariostatic Agents.⁶ All examinations were performed by the same examiner. The findings were recorded by a trained assistant on a standardized optical-scan form and processed by the Biometry Section of the National Institute of Dental Research.

Baseline examinations were conducted in the fall of 1975, prior to the initiation of rinsing, and have been conducted yearly thereafter. The latest examinations, conducted in the fall of 1978, after three years of rinsing, form the basis of this report.

While randomly selected children in grades kindergarten through six were examined, because of natural exfoliation, children in grades five and six were not considered to have enough primary teeth to make analysis meaningful. As seen in Figure 1, of the remaining grade levels, only children in grades three and four at the time of the last examination participated in all three years of the program (average 77 rinse sessions). This report, therefore, presents the effect of fluoride rinsing on the caries prevalence of third and fourth grade children.

Caries Analysis

Since this program was originally established to demonstrate the feasibility of school-based rinsing programs, the opportunity to benefit from fluoride rinsing was extended to all elementary school children. Consequently, there is no concurrent placebo or non-treatment control group as there is in conventional clinical studies of potential cariostatic agents. The

SCHEDULE of FLUORIDE RINSING and DENTAL EXAMINATIONS by GRADE

ACADEMIC YEAR	1975-76	1976-77	1977-78	1978-79
EXAMINATION	BASELINE	1 st YR	2 nd YR	3 rd YR
AVERAGE NUMBER OF RINSES PER YEAR AT TIME OF EXAMINATION	0	19	30	28
ELEMENTARY GRADES (PARTICIPATE IN RINSING)	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> K₀ 1₀ 2₀ 3₀ 4₀ 5₀ 6₀ </div>	K ₀ 1 ₁ 2 ₁ 3 ₁ 4 ₁ 5 ₁ 6 ₁	K ₀ 1 ₁ 2 ₂ 3 ₂ 4 ₂ 5 ₂ 6 ₂	K ₀ 1 ₁ 2 ₂ <div style="border: 1px solid black; padding: 2px; display: inline-block;"> 3₃ 4₃ </div> 5 ₃ 6 ₃

Subscript indicates number of years of rinsing

Figure 1. The pattern of rinsing and examinations since the inception of the mouthrinsing program in 1975. Children in grades three and four in the 1978-79 academic year completed three years of rinsing at the time of the third-year examination. While fifth and sixth grade children also completed three years of rinsing, too many primary teeth are exfoliated to allow a meaningful analysis.

effect of rinsing is not calculated by a determination of incremental caries scores between control and treatment groups. Instead, children in grades kindergarten through six were examined in the fall of 1975, before the program began. The caries prevalence scores obtained at this examination constitute the baseline for this program (Figure 1). All subsequent examinations were performed on rinsing participants and these caries prevalence data were compared to the baseline scores in order to determine the level of effectiveness of the rinsing program.

The caries indices used in this report are the *dfs* (decayed, filled primary surfaces) and the *dft* (decayed, filled primary teeth). Caries indices for the primary dentition may also include an "e" component; i.e., *dfs* and *dft*. The "e" stands for "indicated for extraction" and is used when a primary tooth is grossly destroyed by caries. In our study, teeth with caries involving all surfaces, which were indicated for extraction, received a *dft* score of one and a *dfs* score of four (for anterior teeth) or five (for molars). A "missing" component is not used in caries indices of the primary

dentition, as it is in the DMFT and DMFS indices for permanent teeth, because primary teeth may be missing from exfoliation. While failure to include a "missing" component might introduce a bias by not identifying teeth that were lost from caries, this was not considered to be a significant problem in our study since the level of oral health and the level of dental care in the community was high. The exfoliation factor was further dealt with by excluding older children, fifth and sixth graders, from our evaluation of the primary teeth and by reporting our results as both *dfs*/child and *dfs*/100s, which will be discussed later.

Results

Caries prevalence scores for children who were in the third and fourth grades at the time of the last examination are presented per child (Table 1) and per 100 surfaces (Table 2). Differences between baseline caries scores and those after one, two, and three years of rinsing are listed. After one year of rinsing (19 rinse sessions), the caries prevalence scores are not substan-

Table 1. Mean carious surface prevalence (dfs/child) at baseline and after one, two, and three years of rinsing

Grade	\bar{x} dfs Baseline	\bar{x} dfs 1 Year	Percent Difference	\bar{x} dfs 2 Years	Percent Difference	\bar{x} dfs 3 Years	Percent Difference
3	5.60	4.75	-15.2	4.27	-23.8	4.27	-23.8
4	4.28	4.66	+ 8.9	3.50	-18.2	3.86	- 9.8
Both Grades	4.94	4.71	- 4.7	3.89	-21.3	4.07	-17.6

Table 2. Mean carious surface prevalence (dfs/100s) at baseline and after one, two, and three years of rinsing

Grade	\bar{x} dfs Baseline	\bar{x} dfs 1 Year	Percent Difference	\bar{x} dfs 2 Years	Percent Difference	\bar{x} dfs 3 Years	Percent Difference
3	10.39	8.47	-18.5	7.57	-27.1	7.85	-24.4
4	9.05	10.02	+10.7	6.92	-23.5	8.22	- 9.2
Both Grades	9.72	9.25	- 4.8	7.25	-25.4	8.04	-17.3

tially different from those recorded at baseline. After two years (49 rinse sessions), the reductions in caries prevalence are 21.3 percent (dfs/child) and 25.4 percent (dfs/100s). Three years of rinsing (77 rinse sessions) did not produce an increase in the magnitude of the caries prevalence reduction in the primary dentition; in fact, a decrease occurred.

Table 3 presents mean caries prevalence scores for individual primary tooth surfaces at baseline and after one, two, and three years of rinsing. The greatest reductions after two and three years of rinsing were observed for proximal surfaces.

Figure 2 compares the percent caries reductions for primary and permanent surfaces for children who were third and fourth graders at the time of the last examination. The percent caries reduction increases in the permanent dentition after each year of rinsing. Conversely, in the same children, an increased caries reduction is not demonstrated for the primary dentition between the second and third years of rinsing.

Discussion

With few exceptions,⁷⁻¹⁰ most clinical studies that have tested the effects of school-based fluoride programs on the primary dentition have evaluated either the administration of fluoride tablets or operator-applied topical fluoride treatments. Horowitz and co-workers evaluated a school-based program involving daily ingestion of an acidulated phosphate fluoride tablet, weekly rinsing with a 0.2 percent NaF solution, and home use of a fluoride containing dentifrice.¹¹ After two years, these investigators reported only minimal differences and no consistent pattern when the caries prevalence of the primary molars of six-, seven-, and eight-year-old participants was evaluated. In the only other study reporting the effects of fluoride rinsing on the primary dentition, Birkland and co-workers assessed changes in the dental treatment needs of Norwegian school children.¹² The data for the number of teeth requiring fillings was equivocal, although there was a decrease in the number of pri-

Table 3. Mean caries prevalence scores by type of primary tooth surface for third and fourth grade children at baseline and after one, two, and three years of rinsing

Examination	Proximal Surfaces		Buccolingual Surfaces		Occlusal Surfaces	
	\bar{x} dfs/Child	% Diff.	\bar{x} dfs/Child	% Diff.	\bar{x} dfs/Child	% Diff.
Baseline	1.90		0.78		2.26	
1 Year	1.77	- 6.8	0.70	-10.3	2.23	- 1.3
2 Years	1.32	-30.5	0.56	-28.2	2.01	-11.1
3 Years	1.44	-24.2	0.65	-16.7	1.97	-12.8

DIFFERENCE IN CARIES PREVALENCE IN THE PRIMARY AND PERMANENT DENTITIONS FOR CHILDREN IN GRADES THREE AND FOUR AFTER ONE, TWO, AND THREE YEARS OF RINSING

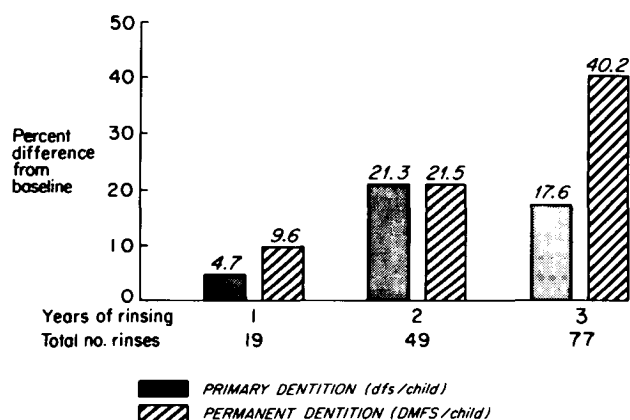


Figure 2.

primary teeth requiring extractions during a three-year rinsing period.

In our study, the caries prevalence reduction to the primary teeth after three years of weekly supervised rinsing with a 0.2 percent NaF solution failed to achieve the magnitude of reduction observed for the permanent dentition (Figure 2). There was little effect to the primary dentition after one year of rinsing (Tables 1 and 2). This was also true for the permanent dentition. After two years of rinsing, the reductions in caries prevalence in both the primary and permanent dentitions were approximately 20 percent. After three years of rinsing, however, the reduction in caries prevalence for the permanent teeth was 40 percent

compared to only 17 percent for the primary teeth in the same children. These results indicate that the effect of topical fluoride therapy to the primary teeth is less than that for the permanent teeth.

That exfoliation did not unduly influence our findings is reflected in the similar caries inhibitions obtained when the data were analyzed by dfs/child (Table 1) and dfs/100s (Table 2). Glass and co-workers have demonstrated that when caries in the primary dentition of progressively older children is analyzed by df surfaces *per subject* (dfs/child), a distortion of the true caries situation can occur because the number of subjects, reflected in the denominator of the equation, remains constant while the number of teeth or surfaces at risk to decay, which is reflected in the numerator, decreases from exfoliation.¹³ However, if caries were analyzed according to the number of *tooth surfaces at risk* (dfs/100s), the caries rates do not appear to be influenced by the exfoliation phenomenon.

Stookey has indicated that the caries reductions to the primary dentition from operator-applied topical fluoride treatments are generally lower than those reported for the permanent dentition.¹⁴ Based upon our results, as well as those of Horowitz, *et al.* and Birkland, *et al.*, the same seems to be true for self-administered fluoride rinses.^{11,12}

While our results do not provide information about the reasons for the different magnitude of response to topical fluorides observed for the permanent and primary dentitions, it is attractive to speculate that one reason may be the difference in tooth age. The primary teeth of school age children represent an "old" tooth population when the number of years since eruption are considered, while the permanent teeth in these same children represent a "younger" population. Many studies have shown that newly-erupted teeth receive greater protection from fluoride compared to

teeth that have been exposed to the oral environment for several years. While it would be interesting to evaluate the effects of fluoride rinsing on a preschool population in order to study recently erupted primary

teeth, such a study is contraindicated (at least with a 0.2 percent NaF concentration), since Ericsson and Forsman have reported that young children swallow, rather than expectorate, most of a rinse solution.¹⁵

References

1. Council on Dental Therapeutics: "Council Classifies Fluoride Mouthrinses," *J Am Dent Assoc*, 91:1250-1251, 1975.
2. Ripa, L. W. and Leske, G. S.: "Two Years' Effect on the Primary Dentition of Mouthrinsing With a 0.2 Percent Neutral NaF Solution," *Community Dent Oral Epidemiol*, 7:151-153, 1979.
3. Leske, G. S. and Ripa, L. W.: "Guidelines for Establishing a Fluoride Mouthrinsing Caries Preventive Program for School Children," *Public Health Rep*, 92:240-244, 1977.
4. Ripa, L. W., Leske, G. S., and Levinson, A.: "Supervised Weekly Rinsing With a 0.2 Percent Neutral NaF Solution: Results From a Demonstration Program After Two School Years," *J Am Dent Assoc*, 97:793-798, 1978.
5. Ripa, L. W., Leske, G. S., Lowey, W. G.: "Fluoride Rinsing: A School-Based Dental Preventive Program," *J Prev Dent*, 4:25-30, 1977.
6. Radike, A. W.: "Criteria for Diagnosis of Dental Caries," *Proceedings of the Conference on the Clinical Testing of Cariostatic Agents*, American Dental Association, Chicago, pp. 87-88, 1972.
7. Bullen, D. C. T., McCombie, F., and Hole, L. W.: "One-Year Effect of Supervised Toothbrushing With an Acidulated Fluoride-Phosphate Solution," *J Canad Dent Assoc*, 31:231-235, 1965.
8. Woods, R.: "A Community Dental Health Project I. Self-Applied SnF₂-ZrSiO₄ Prophylactic Paste and Dental Caries in Primary School Children," *Aust Dent J*, 21:205-210, 1976.
9. Englander, H. R., Mellberg, J. R., and Englar, W. O.: "Observations on Dental Caries in Primary Teeth After Frequent Fluoride Toplications in a Program Involving Other Preventives," *J Dent Res*, 57:855-860, 1978.
10. Schutze, H. J., Jr., Forrester, D. J., and Balis, S. B.: "Evaluation of a Fluoride Prophylaxis Paste in a Fluoridated Community," *J Canad Dent Assoc*, 40:675-683, 1974.
11. Horowitz, H. S., Heifetz, S. B., Meyers, R. J., Driscoll, W. S., and Korts, D. C.: "Evaluation of a Combination of Self-Administered Fluoride Procedures for Control of Dental Caries in a Non-Fluoride Area: Findings After Two Years," *Caries Res*, 11:178-185, 1977.
12. Birkland, J. M., Broch, L., and Jorkjend, L.: "Benefits and Prognosis Following Ten Years of a Fluoride Mouthrinsing Program," *Scand J Dent Res*, 85:31-37, 1977.
13. Glass, R. L., Becker, H. M., and Shiere, F. R.: "Caries Incidence in Human Primary Teeth During the Period of the Mixed Dentition," *Arch Oral Biol*, 15:1007-1014, 1970.
14. Stookey, G. K.: "Fluoride Therapy," in Bernier, J. L. and Muhler, J. C. (eds.): *Improving Dental Practice Through Preventive Measures*, St. Louis: The C. V. Mosby Co., pp. 76-132, 1966.
15. Ericsson, Y. and Forsman, B.: "Fluoride Retained from Mouthrinses and Dentifrices in Preschool Children," *Caries Res*, 3:290-299, 1969.