

Effect of Fluoridated Water in Schools Upon Dental Caries Susceptibility

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APPROXIMATELY one-third of the population of this country lives in areas lacking central public water supply systems. Because fluoridation of public water supplies cannot provide protection against dental caries for this portion of people, other approaches have been attempted and are still being developed.

Interest in fluoridation of school water supplies has increased. Jordan (1) has demonstrated that a community water fluoridation program benefited rural children who received fluoridated water at school. Other studies in progress are designed to determine the effectiveness of school fluoridation and the optimal concentration of fluoride in rural school water supplies.

The purpose of this study was to determine the effect of fluoridation in school water systems upon children who drank fluoride-deficient water in their homes.

Selection of Subjects

In 1960 members of the Oregon State Dental Association, assisted by the Oregon State Board of Health's dental health section, surveyed the dental health status of 4,030 school children within the Parkrose School District of Multnomah County. The district's drinking water is fluoride-deficient (0.0-0.1 ppm).

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In March 1961, a similar survey was carried out to evaluate the effectiveness of fluoridation, begun in January 1953, in the Salem Heights Water District. Suburban Salem Heights is adjacent to the city of Salem. The Salem Heights Water District supplies drinking water to approximately 10,770 residents in households and to the schools in the area. Homes immediately outside the Salem Heights Water District receive fluoride-deficient water from the Salem city water supply or from wells.

Residence histories for the children in Parkrose and in Salem Heights schools were completed in advance by the parents. The children were grouped as follows for purposes of the study.

Group 1. Boys and girls who had lived only in the Parkrose area with fluoride-deficient water, except for absences of not longer than 90 days.

Group 2. Boys and girls in Salem Heights schools who had lived in homes supplied with fluoridated water since birth or since the beginning of the fluoridation program, except for absences of not longer than 90 days.

Group 3. Boys and girls who had lived only outside the Salem Heights Water District in the surrounding area and attended schools supplied by fluoridated water since their first enrollment.

Both Salem Heights and the Parkrose School District lie within the Willamette Valley in western Oregon between the Cascade and the Coast ranges of mountains. The two communities have fairly similar economic and social characteristics. Median school years completed by individuals 25 years of age and older in the

7 census tracts within the Parkrose School District is 12.0. In Salem Heights, median school years completed by those past age 25 is 12.6. Median family income is \$6,505 in Parkrose, \$7,180 in Salem Heights. The two communities are approximately 55 miles apart.

Dental Inspections

All the children were examined in portable dental chairs within the schools. Mouth mirrors and explorers and portable dental lights were used in the examinations which were identical in Parkrose in 1960 and in Salem Heights in 1961. Counts of all decayed, missing, and filled (DMF) permanent teeth were made for each child according to the method described by Klein (2). All decayed and filled primary teeth and primary teeth indicated for extraction were recorded for each child. Standardization of examinations by the dentists was approached by selection of gross criteria for determination of caries activity and by a short indoctrination period at the beginning of each morning and afternoon session. This period was used to acquaint examiners and recorders with the code and to establish consistency among examiners regarding the subjective assessment features of

diagnosis. The first six children in each session were used for repeated examinations and discussion.

Results and Discussion

Table 1 gives the distribution of children examined by age group and the percentage of each group free from dental caries in the permanent dentition. At each age, this percentage is highest for group 2 children, the figure for group 3 children assuming an intermediate position between that of groups 1 and 2 for five of the age groups. Group 2 values were significantly different from group 1 at ages 6, 7, 8, 9, 10, and 13. Group 3 values were significantly different from group 1 at age 7.

Table 2 provides information on caries experience in permanent teeth of the children by age groups in terms of mean numbers of DMF teeth per child. At each age the mean number of DMF teeth per child is lower for each group of Salem Heights children than for the Parkrose children. For Salem Heights children who received fluoridated water both at home and at school, the mean DMF number per child progressed upward from 0.39 at age 6 to 7.27 at age 15. Children who drank fluoridated school water and fluoride-deficient water

Table 1. Distribution of children examined, by age, number, and percentage free of caries in permanent dentition

Age (years)	Group 1. Parkrose District			Group 2. Salem Heights District			Group 3. Outside Salem Heights District		
	Number examined	Caries free		Number examined	Caries free		Number examined	Caries free	
		Number	Percent		Number	Percent		Number	Percent
6-----	186	93	50.00	44	39	¹ 88.64	27	16	59.26
7-----	253	84	32.20	46	32	¹ 69.56	56	32	² 57.14
8-----	215	47	21.86	45	17	³ 37.78	38	11	28.95
9-----	185	16	8.65	42	11	³ 26.19	26	2	7.69
10-----	191	7	3.66	41	12	¹ 29.27	38	4	10.53
11-----	174	7	4.02	33	5	15.15	30	1	3.33
12-----	173	7	4.05	40	5	12.50	86	3	3.49
13-----	149	1	.67	40	5	³ 12.50	127	3	2.36
14-----	105	1	.95	33	1	3.03	114	0	-----
15-----	108	0	-----	11	0	-----	30	0	-----
Total-----	1,739	263	-----	375	127	-----	572	72	-----

¹ Significantly different from group 1 at 0.1 percent level.

² Significantly different from group 1 at 1 percent level.

³ Significantly different from group 1 at 5 percent level.

Table 2. Mean number of DMF teeth and standard error of means, by age, Parkrose and Salem Heights

Age	Group 1. Parkrose District	Group 2. Salem Heights District	Group 3. Outside Salem Heights District
6-----	0.71 ± 0.09	0.39 ± 0.18	0.67 ± 0.21
7-----	1.68 ± .10	¹ .56 ± .15	² 1.02 ± .18
8-----	2.47 ± .13	² 1.71 ± .21	1.97 ± .26
9-----	3.23 ± .13	¹ 2.14 ± .27	3.19 ± .31
10-----	3.88 ± .16	¹ 2.51 ± .36	3.79 ± .22
11-----	4.53 ± .19	3.73 ± .44	4.27 ± .50
12-----	6.42 ± .29	¹ 4.20 ± .24	6.30 ± .51
13-----	8.51 ± .30	¹ 5.25 ± .53	² 7.14 ± .33
14-----	10.12 ± .35	³ 7.61 ± 1.10	10.05 ± .45
15-----	12.55 ± .49	¹ 7.27 ± 1.37	¹ 8.73 ± .91

¹ Significantly different from group 1 at 0.1 percent level.

² Significantly different from group 1 at 1 percent level.

³ Significantly different from group 1 at 5 percent level.

at home had mean DMF values ranging from 0.67 at age 6 to 8.73 at age 15. Mean DMF values in Parkrose were from 0.71 at age 6 to 12.55 at age 15. For groups 1 and 2, differences in means were significant at all ages except 6 and 11. Comparing group 1 and group 3, differences in means were significant at ages 7, 13, and 15. Since all differences were in favor of groups 2 and 3, it would appear that larger samples at the other ages would yield significant differences.

Tests of significance were performed as follows using methods described by Dunning (3):

1. For differences between proportions:

$$CR = \frac{p_2 - p_1}{\sqrt{\frac{p_1 q_1}{n_1} + \frac{p_2 q_2}{n_2}}}$$

Where p = proportion of children who are caries-free and $q = 1 - p$.

2. For differences between means:

$$CR = \frac{\bar{X}_2 - \bar{X}_1}{\sqrt{(SE_{\bar{X}_1})^2 + (SE_{\bar{X}_2})^2}}$$

A critical ratio of 1.96 or higher implies significance at the 5 percent level, one of 2.58 or higher significance at the 1 percent level, and 3.29 or higher at the 0.1 percent level.

In order to strengthen the hypothesis that school fluoridation was responsible for decreased susceptibility to caries in group 3 chil-

dren, an investigation of dental caries experience in primary teeth was indicated. Any decreased susceptibility in teeth erupting far prior to school entrance for children who had attended school for a very short period of time would indicate that some other factor was active in inhibiting the disease. For 6-year-olds, mean def teeth per child in group 2 was 3.64 ± 0.52 ; in group 3, 6.07 ± 0.73 . The difference in means is significant at the 1 percent level. The higher susceptibility to decay in primary teeth for group 3 children of this age suggests the preventive factor was not in effect before they started to school.

Summary

Children who received fluoridated water at school and in their homes have received protection against dental caries attack.

Children who lived in homes supplied with fluoride-deficient water but who attended school within the fluoridated water area have also received some protection against dental caries, although the benefits have been less than for children who drank fluoridated water at home and at school.

Further studies are needed to determine optimal concentrations of fluorides in school water supplies for communities lacking central water sources. Since rural school children attending a school with a fluoridated water supply would have access to that water for approximately 180 days or one-half the year, and for approximately 7 of the 12 waking hours a day, studies may be expected to reveal whether increasing the fluoride concentration above 0.7–1.2 ppm would provide benefits more nearly approaching those now received by children who ingest fluoridated water both at home and at school.

REFERENCES

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