

The prevalence of fluorosis-like lesions associated with topical and systemic fluoride usage in an area of optimal water fluoridation

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Abstract

The frequency of using self-applied (over-the-counter) fluoride products and prescribed supplemental fluorides, and the prevalence of fluorosis-like enamel lesions in the permanent dentitions of children living in an optimally fluoridated urban community were investigated. Subjects were selected randomly, and consent forms and questionnaires concerning fluoride usage and residency status were provided to guardians prior to examination. After a supervised tooth brushing event, 300 consenting subjects were examined by the principal investigator using Dean's index to assess levels of fluorosis-like lesions. The principal investigator was standardized with another investigator prior to the examinations to obtain an interexaminer agreement level of 97%, and an intraexaminer agreement level of 96%. Portable dental equipment was used during all examinations. Chi-square analysis indicated no statistically significant difference between the frequency of tooth brushing with a fluoridated dentifrice at an early age and the prevalence of fluorosis-like enamel lesions. However, there was a significant difference ($P < 0.05$) between the prevalence of fluorosis-like lesions, and the frequency of using prescribed fluoride supplements and gels, and over-the-counter rinses.

Water fluoridation has been recognized as one of the major public health accomplishments during this century (Butler et al. 1985), and today more than one-half of the population of the United States, including children, receive fluoride systemically by drinking water that contains fluoride in optimal concentrations (Ripa et al. 1986). Although some recent reports have indicated that there is no clear epidemiologic evidence indicating an increase in the prevalence of fluorosis (Heifetz and Horowitz 1986), other studies (Leverett 1982, 1986) have suggested that indeed the prevalence of dental fluorosis in children has increased when compared to levels reported by Dean et al. (1942). Current theories seem to suggest that the increase in fluorosis may be due to the

ingestion of fluorides additional to that obtained from fluoridated water supplies (Taves 1977). It is postulated by some, that the additional fluoride may be obtained from the wide variety of fluoride-containing products such as prescribed supplements and gels, and over-the-counter rinses and dentifrices, which are readily available in the marketplace (Levy 1986). Consequently, when these products are used by children who are already consuming optimally fluoridated water, the additional fluoride consumed during the calcification stages of tooth development may contribute to the presence of some level of enamel fluorosis in these children.

This study was designed to determine the relationship between the frequency of the use of self-applied (over-the-counter) and prescribed supplemental fluorides and the prevalence of fluorosis-like lesions of enamel in the dentitions of children residing in an optimally fluoridated urban community.

Materials and Methods

Three hundred subjects aged 6-13 were included in the study. All subjects attended 1 of the 6 elementary schools which agreed to participate in the study. The schools represented 6 geographic areas of the community, enabling the investigators to obtain subjects from different socioeconomic backgrounds.

Consent to utilize the schools for the project was obtained and students from random classrooms from each grade level (kindergarten through grade 6) were selected to participate in the study. Participants were given a consent form, information questionnaire, and an introductory letter for their parents or guardians. The forms were distributed 1 week prior to the examination date, and the children were asked to return the signed and completed forms to their classrooms within 1 week.

Children with signed consent forms and questionnaires then were examined for fluorosis-like lesions in

the permanent dentition. Prior to examination, each child was given a soft toothbrush and was instructed to brush under supervision of the principal investigator. No dentifrice or water was used in any of the brushing sessions. All examinations were performed by the principal investigator using a portable dental chair, portable light, and an intraoral mouth mirror. The teeth were scored using Dean's index of mottled enamel (Dean 1942). The overall fluorosis score was based on the most severe form of fluorosis-like lesions recorded for 2 or more teeth. Teeth were not included in the study if they were banded orthodontically, were partially erupted, or were tetracycline stained. Standardization of the principal investigator with another investigator was accomplished prior to the examinations, and an interexaminer agreement level of 97% was obtained concurrent with an intraexaminer agreement level of 96%.

After the data were collected and baseline fluoride levels determined for each subject, the data were categorized further according to residential history, age, sex, fluoride use, and geographic location. The differences in frequencies between the categorized data were examined statistically with Chi-square analysis where the differences were considered significant at $P < 0.05$.

Results

Although 300 subjects aged 6-13 were examined, the data presented here pertain only to 206 life-time resident subjects attending 4 of the 6 schools examined in the study. Data obtained from 2 of the schools were not included in statistical analysis because of the small sample size.

To facilitate the statistical analysis, the data regarding questionnaire responses about fluoride use were analyzed by collapsing the number of frequency responses into 2 categories: (1) very frequently, frequently; or (2) sometimes, seldom, and never. In order to further analyze the data, and because of similar socioeconomic traits of several of the geographic areas tested, scoring results of 3 schools were considered together in the Chi-square analysis. The school in the north-central area of the city was considered a separate entity during the data analysis because of its unique socioeconomic and educational characteristics.

Table 1 represents data regarding tooth brushing frequencies and fluorosis scores for life-time resident subjects attending each of the 4 schools. Data are based on subjects with normal translucent enamel categorized with a fluorosis score of 0.0, and subjects with enamel demonstrating at least questionable fluorosis (white flecks, spots, or lines) categorized with a fluorosis score of 0.5 or greater. The data indicate that there was no significant difference between tooth brushing frequencies and fluorosis scores in any group.

TABLE 1. Comparison of Fluorosis Scores to Frequency of Brushing by Socioeconomic Categories

School name	Frequencies	Fluorosis Score 0.0	Fluorosis Score 0.5+
1 DB, PCA AE	Very frequent or frequent	120	18
	Sometimes, seldom, or never	28	3
2 JP	Very frequent or frequent	20	13
	Sometimes, seldom, or never	2	2

1 $df = 1$, $\chi^2 = 0.102$, $P > 0.75$, NS at 0.05 level.

2 $df = 1$, $\chi^2 = 0.166$, $P > 0.5$, NS at 0.05 level.

The data pertaining to the frequency of using fluoride supplements, as reported by subjects in the 4 schools, indicate that fluorosis levels and frequency of supplement use were significant at the 0.05 level (Table 2).

Similarly, the frequency of gel and rinse use and the fluorosis levels reported for schools AE, DB, and PCA were also significant at the 0.05 level. The frequency of gel and rinse use and the fluorosis levels reported for subjects attending the school JP, however, were not significant (Table 3).

TABLE 2. Comparison of Fluorosis Scores to Frequency of Fluoride Supplement use by Socioeconomic Categories

School Name	Frequencies	Fluorosis Score 0.0	Fluorosis Score 0.5+
1 DB, PCA AE	Very frequent or frequent	4	8
	Sometimes, seldom, or never	147	13
2 JP	Very frequent or frequent	2	7
	Sometimes, seldom or never	17	8

1 $df = 1$, $\chi^2 = 31.889$, $P < 0.001$, Sig. at 0.05 level.

2 $df = 1$, $\chi^2 = 36.723$, $P < 0.001$, Sig. at 0.05 level.

TABLE 3. Comparison of Fluorosis Scores to Frequency of Fluoride Gel/Rinse Use by Socioeconomic Categories

School Name	Frequencies	Fluorosis Score 0.0	Fluorosis Score 0.5+
1 DB, PCA AE	Very frequent or frequent	19	9
	Sometimes, seldom, or never	132	12
2 JP	Very frequent or frequent	1	2
	Sometimes, seldom, or never	18	13

1 $df = 1$, $\chi^2 = 12.39$, $P < 0.001$, Sig at 0.05 level.

2 $df = 1$, $\chi^2 = 0.6723$, $P > 0.05$, NS at 0.05 level.

Additionally, a comparison of the 2 school groups using a Chi-square analysis, suggests that there were no significant differences in terms of fluoride use frequency or fluorosis scores.

Discussion

The majority of subjects presented with either normal enamel or with questionable fluorosis-like lesions. These findings are in agreement with other authors who have reported similar results (Horowitz et al. 1984; Segreto et al. 1984). Although the surface irregularities demonstrated by questionably fluorosis-like enamel are minimal, these lesions may be more noticeable to children living in today's esthetic conscious society.

Information regarding fluoride use by each subject was obtained from questionnaire responses based on the recall of the parent/guardian. Since a verbal interview of parents/guardians was not possible, the questionnaire was designed to elicit pertinent information using simple terms and general frequency qualifiers such as very frequently, frequently, sometimes, seldom, and never. Although these types of qualifiers are subjective in nature, they were utilized so that the questionnaire could be understood and completed by the parents/guardians without verbal assistance. Because of these constraints, however, the absolute accuracy of the responses given may be limited and further studies may be indicated in order to obtain more definitive data.

In this study, it was postulated that subjects from a higher socioeconomic status and greater educational background would utilize both prescribed and over-the-counter fluorides more frequently than subjects in lower socioeconomic groups. Therefore, because the socioeconomic status and educational background of residents living in the north-central portion of the city has traditionally been considered higher than in other areas of the city, the data collected from that school was analyzed separately and compared to the combined data obtained from the other schools. The data presented, however, indicate that there were no significant differences between the groups in terms of fluoride use. Consequently, socioeconomic status and education did not seem to influence the use of fluorides by subjects in this study.

Consideration of the data regarding the use of prescribed and over-the-counter fluorides and the prevalence of fluorosis-like lesions also elicited some interesting findings. Some authors, (Ekstrand and Ehrnebo 1980) for example, have suggested that tooth brushing at an early age with a fluoridated dentifrice may be a major contributor to the presence of fluorosis-like lesions.

In this study, however, although the majority of subjects examined reported tooth brushing very fre-

quently or frequently at younger than 3 years of age, there was no significant difference between tooth brushing frequency and fluorosis scores in any group. This would seem to indicate that although children are brushing frequently at a young age, ingestion of fluoridated toothpastes alone may not be directly related to the presence or absence of fluorosis-like lesions.

Unlike tooth brushing, however, the use of fluoride supplements, gels, and rinses exhibited some statistically significant findings. These findings imply that an increase in the use of fluoride supplements especially, and to a lesser extent the use of fluoride gels and rinses, may suggest an increase in the prevalence of fluorosis-like lesions. It is important to note that these results are based on the frequency of fluoride administration alone and therefore differ from other research (Butler et al. 1985) in which conclusions were based on the age when supplements were used and not necessarily on the frequency of their use. Consequently, because of the importance of both tooth development at the time of fluoride administration and the frequency with which fluorides are administered, additional studies which assess the prevalence of fluorosis in a single population should be designed to consider both parameters.

It must be remembered that the data presented pertaining to fluoride use frequency was obtained from subjects with a history of optimal water fluoridation; therefore, the conclusions from this study regarding fluoride use and the prevalence of fluorosis-like lesions must only be applied to subjects consuming optimally fluoridated water. The data presented indicate a need for comprehensive awareness in the administration of supplemental fluorides, fluoride gels, and fluoride rinses, especially when they are recommended and administered by health professionals in areas of optimal water fluoridation.

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Toothpick Tales

Gardner P.H. Foley, writing in the *Journal of the American College of Dentistry*, presents some interesting tidbits about the use of the toothpick.

Toothpicks have been made of various kinds of wood and of several metals. In 1876 U.S. toothpick patents were awarded to at least two applicants. George Clark, Jr., of Boston, received his for "a wooden tooth pick, artificially impregnated with a flavor or perfume." W.W. Wallace, of Philadelphia, patented a toothpick described as "a bow-shaped piece, from the ends of which an elastic cord is stretched."

G.V. Black, writing in 1867, made an interesting comment on the toothpick: "One of the most common errors is the rubbing or washing (the teeth) with a napkin or rag...(The toothpick) is capable of doing more to prevent decay of the teeth than any other instrument ever used upon them."

In 1896 the *British Journal of Dental Science* published details of a new industry started in Alaska, the preparation and sale of walrus whiskers for toothpicks: "When a walrus is killed, the natives pull out each separate hair. They are thoroughly dried, arranged in neat packages and exported to China where they are much sought after by the upper classes."

One author, Gerald B. Lambert, an advertising pioneer who popularized his family's Listerine® product, told the following anecdote in his autobiography *All Out of Step*. Lambert was often a dinner guest of the royal family of Spain at Santander, the summer capital. "The table was set in gold plate. It was at these dinners that I encountered something I have never seen before or since. Each guest had by his plate a gold toothpick. This was not a decoration. It was used vigorously and with evident delight."