

Prevalence of Endemic Fluorosis in Israel at Medium Fluoride Concentration

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A LOW PREVALENCE of dental caries has been repeatedly reported from countries of the Near and Middle East, including Israel. Sometimes these findings were associated with occurrence of dental fluorosis (1,2). In other instances no accompanying mottling of teeth was found (3-5). The present study is concerned with observation of endemic fluorosis in a suburb of Haifa, in the coastal plain of Israel.

While an expert committee on water fluoridation appointed by the World Health Organization stated without qualification that "1 ppm fluoride has been shown to give maximum benefits" (6), many investigators and public health administrators have pointed out that local factors may strongly influence the intake of fluoride and must therefore be considered in determining the optimum amount in the drinking water. Otherwise an excessive amount of objectionable fluorosis may be expected. McClure (7), who surveyed the fluoride intake of children 1 to 12 years of age, pointed out that foods highest in fluoride, seafoods and tea, do not usually occur in appreciable quantities in the diet of American children. Based on observations of fluorosis in communities with less than 1 ppm fluoride in the water supply, Maier (8) discussed the influence on water consumption of mean annual temperature, relative humidity, and uniformity of temperature by day and night and combined this factor with air tem-

perature in a graph for determination of the optimum fluoride level under various conditions. Galagan and Lamson (9) found that community fluorosis indices of Arizona communities were considerably higher than those of cities with the same fluoride concentration but with a cooler climate. Galagan and Vermillion (10) calculated a formula for determining the optimum concentration, using the mean maximum temperature. Kroschel and associates (11) found that the naturally occurring fluoride content, 0.60 to 0.70 ppm, in the communal water supply of Jacksonville, Fla., effected a degree of caries reduction as adequate as any found in other communities whose public water supplies contained higher concentrations and that no objectionable or harmful fluorosis had resulted. Striffler (12) summarized all the factors to be taken into account when the fluoridation of local water supplies is considered.

A 1957 survey on dental health of Israeli school children revealed only 54 cases of fluorosis out of a sample of 4,500 children, 35 of whom were immigrants from countries where fluorosis is endemic (3). It was thus concluded that "bearing in mind the amount of fluorine in the local water supplies, fluorosis is bound to disappear in Israel." However, the survey indicated that many children from Qiryat Haiyim, suburb of Haifa, exhibited mottling of teeth, and a theory was even advanced as to the origin of excess fluoride in the local water supply. Since the occurrence of endemic fluorosis could give important information about the optimum concentration of fluoride under conditions prevailing in Israel, it was decided to investigate the matter thoroughly.

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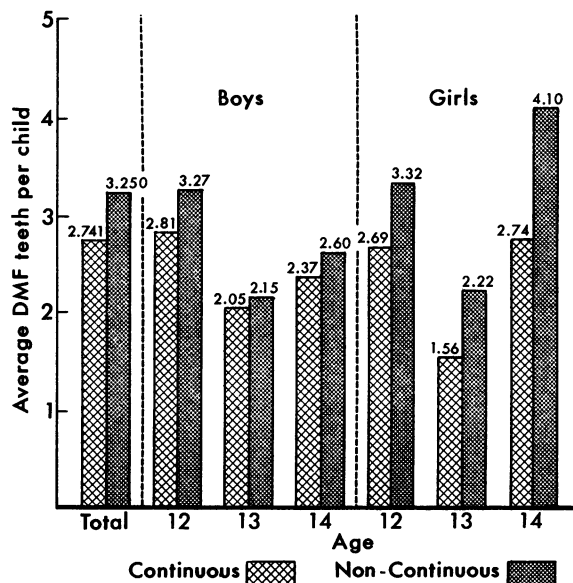
Qiryat Haiyim was founded about 25 years ago as a smallholders' settlement in the Bay of Acre, northeast of the city of Haifa. As this area developed and became the center of Israel's heavy industry, Qiryat Haiyim was rapidly urbanized and now has about 5,000 inhabitants. Water is supplied from 20 wells, which as a rule supply the blocks adjacent to them. However they are interconnected, and in case of excessive demand in a certain area additional water from another source is switched in. The town is situated 9.6 meters above sea level. Although pumping was started at 5 meters above sea level, continuous sinking of the water table required deepening of the wells, and they are at present 10 meters below sea level. As a consequence the mineral content of the water increased and now amounts to 800 mg/l. Fluoride concentration varies between 0.35 and 0.95 ppm, with most of the 20 wells containing 0.66-0.75 ppm:

Concentration	Number of wells
.35-.40	1
.41-.45	1
.46-.50	1
.61-.65	1
.66-.70	3
.71-.75	5
.76-.80	2
.81-.85	3
.86-.90	2
.91-.95	1
Total	20

Material and Methods

All native Israelis in the 6th, 7th, and 8th grades of three schools of Qiryat Haiyim were examined orally. Dr. Abkewitz performed the examinations by daylight, using plane mirror, explorer, and chipblower. Caries was registered in terms of decayed, missing, and filled teeth (DMF); fluorosis was graded according to Dean's classification (13). Records of those examined were divided into two groups: those of children born and reared in Qiryat Haiyim who, according to their parents' certification, had never been absent from the town for a continuous period of more than 1 month, and those of children whose residence in Qiryat Haiyim

Figure 1. Average number of DMF teeth per child for continuous and noncontinuous residents in Qiryat Haiyim, by age and sex



had been interrupted by absences of longer than 1 month. At time of examination Dr. Abkewitz did not know to which group a child belonged.

Observations

The findings of dental caries and fluorosis are summarized in the table and in figures 1 and 2. A definite trend of higher caries prevalence of the noncontinuous residents is observable in all subgroups. In contrast, the rate of children affected with fluorosis is higher in the group of continuous residents, although the difference between the rates is not statistically significant ($P > .05$).

The fluorosis index of Qiryat Haiyim, based on the whole sample of 262 children, is 0.53.

Discussion

The differences both in caries prevalence and in fluorosis between the two groups of children are marked though not statistically significant. A significant difference, however, was not to be expected, first, because of the small sample and the necessity for subdivision according to sex and age, and second, because most of the children not continuously resident at Qiryat Haiyim nevertheless spent most of their lives there

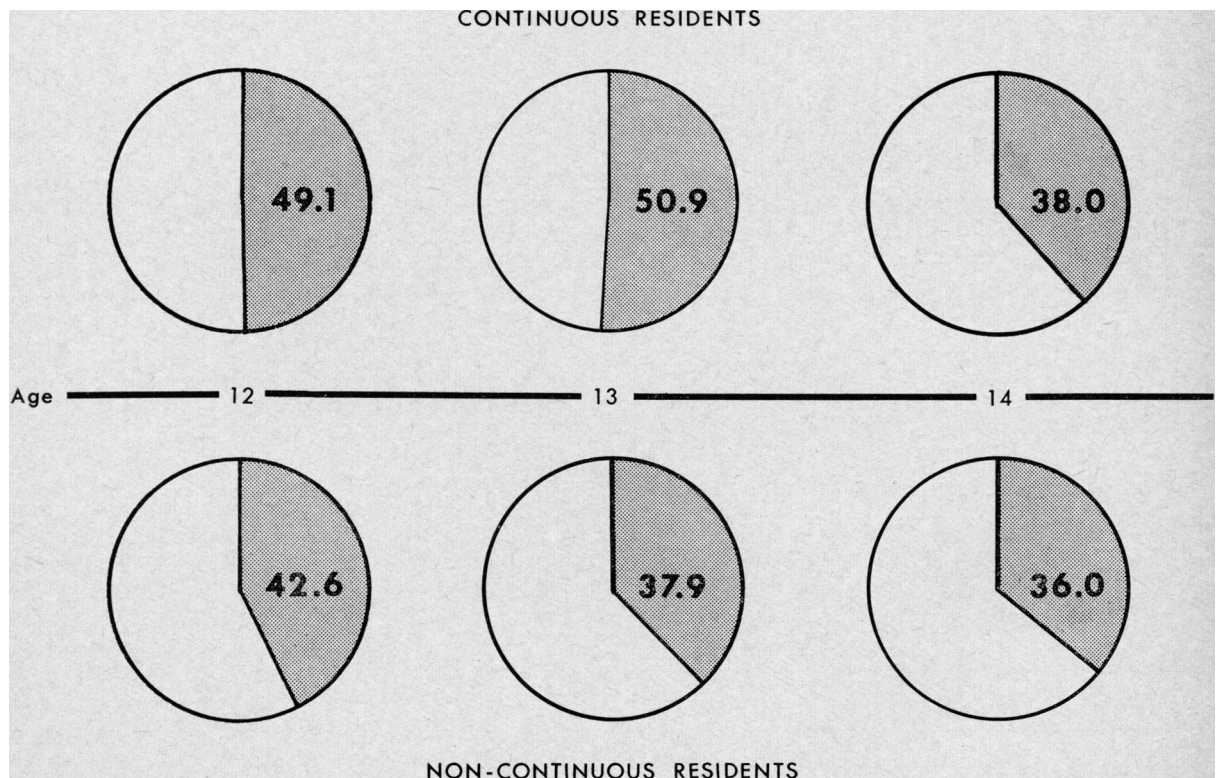
and used the local water during tooth development. Caries prevalence in both groups is within the limits observed in the major cities of Israel, where fluoride was present at concentrations of 0.3–0.6 ppm (Tel Aviv and Haifa) and

0.5 ppm (Jerusalem) (14). Fluorosis, by contrast, is far more prevalent. Of the 262 children in Qiryat Haiyim, more than twice as many were found affected as in the 4,500 examinees of the countrywide survey.

Dental caries and fluorosis in children in Qiryat Haiyim, by residency, sex, and age

Sex and age (years)	Continuous residents						Noncontinuous residents					
	Examined	Average DMF teeth	Fluorosis				Examined	Average DMF teeth	Fluorosis			
			None	Very mild	Mild	Moderate			None	Very mild	Mild	Moderate
<i>Boys</i>												
12-----	22	2.81	7	10	3	2	21	3.27	12	7	2	0
13-----	23	2.05	11	8	3	1	13	2.15	10	1	2	0
14-----	19	2.37	9	9	1	0	15	2.60	11	3	1	0
<i>Girls</i>												
12-----	35	2.69	22	10	3	0	25	3.32	19	6	0	0
13-----	32	1.56	16	13	3	0	16	2.22	8	6	2	0
14-----	31	2.74	22	8	1	0	10	4.10	5	3	2	0

Figure 2. Percentage of children in Qiryat Haiyim affected and not affected by dental fluorosis



The mean maximum temperature at Qiryat Haiyim for the period 1948-54 was 77.9° F. Thus the optimum fluoride concentration calculated according to the formula devised by Galagan and Vermillion (10) would be 0.76 ppm. These authors state that "to obtain a fluoride concentration lower than 0.7 ppm with this formula, the mean maximum temperature would have to average at least 90.6° F." It may be assumed that the average fluoride content of the water in Qiryat Haiyim was near the calculated optimum. Nevertheless, the community fluorosis index is near the upper level of what was called by Dean (13) "zone of borderline significance." If the optimum concentration of fluoride intake is defined as that "which in epidemiological and clinical observations has been found to combine the highest degree of caries protection with the lowest degree of mottled enamel" (15), the fluoride content of the local water supply of Qiryat Haiyim is definitely too high, and the amount of fluorosis observed is not justified by the slight reduction of caries prevalence. Possibly water intake is higher than in comparable areas in the United States, but without any doubt seafood and especially tea are more important items in the diet of Israeli children than of American children and may serve as additional sources of fluoride.

Summary and Conclusions

Examination of 262 children in Qiryat Haiyim, a suburb of Haifa, Israel, revealed the presence of endemic fluorosis. Local water contains about 0.75 ppm fluoride, the optimum level according to the formula of Galagan and Vermillion. Fluorosis was less prevalent and caries experience slightly but consistently higher in both sexes and at all ages in children who had been absent from Qiryat Haiyim for a continuous period of at least 1 month, but the mean DMF teeth of all age groups was within the limits observed in the major cities of the country.

Climatic conditions which increase intake of fluids, as well as additional sources of fluoride in the childrens' diet, may cause the endemic fluorosis.

The slightly increased protection against

caries does not justify the observed amount of fluorosis.

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