

Dental fluorosis and caries incidence in rural children residing in a high fluoride area in the dry zone of Sri Lanka

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Summary

A study was conducted to establish the prevalence and severity of dental fluorosis and to investigate its relationship to dental caries in 222, 12-14 year old children who have been life long residents in a rural area in the dry zone of Sri Lanka where the drinking water contains an above-optimal fluoride concentration. Dental fluorosis was assessed using the WHO criteria. Samples of water used for drinking by them were analysed for fluoride levels. The results revealed that 97% of the children were affected with dental fluorosis. Three per cent was completely free of dental fluorosis while about 20 per cent had extensive fluorosis (scores of 3 and 4). Fluoride levels in the drinking water samples varied from 0.21-9.8 ppm. Higher fluorosis scores were observed in children drinking water with higher fluoride content. The prevalence of caries increased as the degree of fluorosis increased. The mean DMFT was 0.43 in children showing no fluorosis but increased up to 1.65 in children showing a fluorosis score of 3.

Introduction

It is well documented that excess fluoride intake during the period of tooth formation causes dental fluorosis (1, 2). The fluoride appears to affect the activity of ameloblasts, especially during the late secretion and early maturation of enamel (3). The period of susceptibility for an individual may spread up to the time of formation of the crowns of third molar permanent teeth, the period of concern being the first 7-8 years of life.

Possible sources of fluoride known to be strong enough to cause fluorosis include drinking

water, inadvertent swallowing of fluoridated toothpaste, dilution of concentrated and powdered infant formula with fluoridated water and possible dietary practices of excessive consumption of tea or fish.

Endemic dental fluorosis has been reported from different regions of the world where excessive amounts of fluoride are contained in the drinking water (4,5). In Sri Lanka too endemic dental fluorosis has been reported, especially in the North Central Province (NCP), where the prevalence rate reported is about 51-77% (6). Dental fluorosis prevalent in the NCP of Sri Lanka is attributed to water-borne fluorides.

The purpose of this study was to establish the prevalence and severity of dental fluorosis and to investigate its relationship to dental caries in a group of 12-14 year old children residing in an area in the dry zone of Sri Lanka where the drinking water contains high fluoride concentrations.

Material and Methods

Selection of the sample

The sample selected for the present study belongs to a community living in a rural hamlet known as Eppawela in the North Central Province of Sri Lanka. This area located in the dry zone, has a mean maximum annual temperature of 32° C. As there is no pipe-borne water supply to this area, all families residing in this area obtain their drinking water exclusively from wells.

The children included in the present study were selected from the secondary schools of the area. A sample of classrooms with children aged 12-14

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years was selected using a simple random sampling technique. All the children in the selected classrooms who were present on the day of the investigation constituted the study sample. However the children who were not life long residents of this area were excluded from the study.

The oral cavities of the children were examined under natural daylight to determine the dental fluorosis and prevalence of caries. The teeth were cleaned before examination. Severity of dental fluorosis was assessed using the modified Dean's index (7) with a range from normal enamel (score 0) to severe fluorosis (score 4). A score was assigned to each tooth present in the oral cavity. The fluorosis score assigned to an individual corresponds to the more severe score assigned for two teeth.

Dental caries levels were evaluated following the WHO criteria (1987). Examinations for dental fluorosis were carried out by one examiner (D.N.) and those for dental caries by another (M.S.C). An interexaminer variability, therefore did not exist. The intraexaminer variability was assessed by re-examination of 20% of the sample each day during the study. An intraexaminer level of agreement between 0.82-0.87 and 0.79-0.86 was obtained for dental fluorosis and dental caries respectively

The fluoride concentrations of drinking water samples collected from the children were analysed using the ion specific electrode method.

Results

A total of 222, 12-14 year old children participated in the survey. The majority of the children belonged to the low socio-economic group. 52.7 per cent of children studied were females, 53.2 per cent were 12 years old, 28.8 per cent were 13 years old and 18 per cent were 14 years old.

As there were no significant differences in dental fluorosis scores between males and females or between different age groups, the results are presented for the total sample.

Table 1 shows the distribution of dental fluorosis according to the Dean's classification. The results reveal that a mere 3 percent was completely free of dental fluorosis and showed normal tooth surfaces. 83.34 percent of the sample had a fluorosis score of 1 or above. Approximately 20 percent of the sample showed extensive fluorosis (score of 3 or above), whereas 66 percent showed mild fluorosis. The prevalence of severe fluorosis with pitting and chipping off enamel was seen in 5.4% of the sample.

Table 1

Percent distribution of fluorosis in the sample by Dean's fluorosis index

Fluorosis score	n	Percentage
0 (normal)	07	3.15
0.5 (questionable)	30	13.51
1 (very mild)	80	36.04
2 (mild)	59	26.58
3 (moderate)	34	15.32
4 (severe)	12	5.40

n= number of children

Table 2 shows that the prevalence of caries increases as the degree of fluorosis increases. The caries prevalence among the children showing a fluorosis score of 0, 0.5, 1, 2, 3 and 4, was 14.7, 16.7, 35.9, 36.8, 51.9 and 33.3 percent respectively. The mean DMFT varied between 0.43-1.65 and it increased with the degree of fluorosis. However, in the group showing a fluorosis score of 4, the mean DMFT was 1.09.

Fluoride levels in the samples of drinking water collected varied from 0.21 to 9.8 ppm. Table 3 shows the percent distribution of fluorosis scores in the sample according to the water fluoride concentration. Higher dental fluorosis scores are observed among the children whose water contained a high fluoride content.

Table 2

Mean DMFT score for children according to the fluorosis classification

Fluorosis score	n	D	M	F	DMFT
0	07	0.43	0	0	0.43
0.5	30	0.73	0	0	0.73
1	80	0.94	0.03	0.06	1.03
2	59	1.02	0.03	0	1.05
3	34	1.41	0.12	0.12	1.65
4	12	0.91	0.18	0	1.09

n = number of children

DFMT = Decayed; Filled; Missing; Teeth

Table 3

Percent distribution of fluorosis scores in the sample according to the fluoride concentration in water

Water F level (ppm)	Fluorosis index					
	0	0.5	1	2	3	4
< 1	2.70 (6)	9.91 (22)	20.72 (46)	8.11 (18)	3.60 (8)	0
1-3	0.45 (1)	3.60 (8)	11.71 (26)	13.52 (30)	7.21 (16)	1.80 (4)
> 3	0	0	3.61 (8)	4.95 (11)	4.51 (10)	3.60 (8)
All	3.15 (7)	13.51 (30)	36.04 (80)	26.58 (59)	15.32 (34)	5.40 (12)

F = Fluoride

Discussion

All families living in Eppawela obtain their drinking water exclusively from wells. Due to the scarcity of water, many tube wells drawing water from a depth of 36-75M have been constructed in convenient locations for the villagers to obtain their water. Analysis of water samples from the wells showed the fluoride concentration in the ground water to vary from 0.21 to 9.8 ppm. The fluoride content was much greater in the water samples obtained from tube wells, one being as high as 9.8 ppm.

The prevalence of fluorosis in the present study, 97 percent, is much greater than the values reported in previous studies done in Sri Lanka (8,9). In these studies tube well water as a source of excessive fluorides is unlikely, as these wells were constructed much later than the period of development of the permanent dentition of the subjects studied. Widespread use of fluoridated toothpaste was also not prevalent at that time. The increase in the prevalence observed in the present series could be attributed to the high fluoride content in tube well water.

Previous studies have shown increasing caries rates with the increasing fluorosis severity (10, 11). The caries prevalence measured by DMFT was 0.43 in the children who showed no evidence of fluorosis. It increased up to 1.65 in the group that had moderate fluorosis (score 3). This value is greater than the national DMFT value of 1.44, of children at 12 years in Sri Lanka (12). The mean DMFT of 1.09 among the children showing a fluorosis score of 4 was lower than that shown by children having a fluorosis score 3. The sample studied had a smaller number of children with the fluorosis score of 4 (extensive fluorosis).

The caries protective effect of fluoride appears to decline as the level of fluorosis increases. Driscoll *et al* (1986) showed that children having a Dean's fluorosis scores of 3 and 4 had a greater susceptibility to caries. The hypoplastic tooth surfaces of severe fluorosed teeth are likely to retain more food debris and plaque, giving rise to increased susceptibility to caries. As such, the

high levels of fluoride in the drinking water does not seem to yield any beneficial effect on the reduction of caries.

The appearance of higher dental fluorosis scores in children consuming water with low fluoride concentrations suggests that there are other contributory factors. The data showed that 64 per cent of the sample to be using fluoridated toothpaste. The extensive use of fluoridated toothpaste could be another factor that increased the prevalence of fluorosis. Samples of food items commonly consumed by these children and vegetables grown in their own gardens were analysed to find the fluoride content. The data revealed most samples, especially the green leaves, pulses, certain vegetables etc grown in this area to contain high fluoride contents. The most commonly used beverage in this community is tea, which is known to contain high contents of fluoride. It has been estimated two to four cups of tea a day would on an average provide 0.6-1.2 mg of fluoride (13). This could be another contributory factor. The hot and dry climate prevailing in this area may influence the quantity of water consumed and thereby contribute towards fluorosis.

Since the high fluoride level in the drinking water bears no beneficial role in the reduction of dental caries and is a major contributory factor towards the aesthetically unacceptable dental fluorosis, methods of defluoridation need to be promoted in these areas to remove fluorides from drinking water. Until such times wells containing low levels of fluorides need to be identified for the villagers to obtain drinking water and health education programmes regarding the aetiology and prevention of the 'stains' present in their teeth, need to be initiated.

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