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Bibl. RU. Utrecht

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"Indian journal of medical
research"

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Indian J Med Res 77, January 1983, pp 112-118

Dental fluorosis in Ledhupur and Rustampur villages near Varanasi

S.K. Ray*, S. Ghosh, I.C. Tiwari, P. Kaur, D.C.S. Reddy and J. Nagchaudhuri

*Departments of Preventive and Social Medicine, and Physiology
Institute of Medical Sciences, Varanasi*

Revised article received June 11, 1982

A survey was carried out in two villages near Varanasi covering 2159 subjects. Dental mottling was observed in 24.91 per cent of the subjects but no case of skeletal fluorosis was detected. The prevalence of dental fluorosis was low in children below 5 yr of age but it sharply increased thereafter to a maximum prevalence in the 11 to 15 yr age group. Among individuals beyond that age, there was gradual decline in prevalence. In general, the prevalence was higher among males than among females and in those who were residing in the study area since birth than in the immigrants. The fluoride level of the drinking water collected from the wells ranged from 0.2 to 2.1 ppm (mean 0.9 ± 0.38 ppm). A positive association between dental fluorosis and fluoride concentration in drinking water was noted.

Mottled enamel or dental fluorosis is a well known disease entity. In its mild form the disease is characterised by small opaque paper white areas scattered over both the surfaces of the tooth. In severe cases, discrete or confluent pits with brown stain produce a corroded appearance. It represents a partial failure in enamel formation—a non-specific response to a variety of stimuli, one of which is ingestion of excess fluoride. Being a developmental injury, excess of fluoride has no effect on erupted teeth¹.

Fluorine is widely distributed in nature. The soils of different areas vary greatly

in their fluoride content. Man obtains fluorides from ingestion of water. Fluoride contaminated food additives and fluorinated pesticides may be contributory¹.

In India, Shortt *et al*² first described the disease in 1937 while investigating the occurrence of a new mystery disease in Nellore district of south India. The disease was characterised by symptoms of pain, stiffness of spine and chocolate coloured mottling of teeth. Subsequently, high prevalence of dental fluorosis was reported from different parts of Andhra Pradesh³⁻⁵ and in Punjab⁶. The disease

* Present address : Department of Preventive and Social Medicine, Burdwan Medical College, West Bengal

has also been reported from Rajasthan⁷ UP⁸, Madras and Mysore⁹.

Cases of dental fluorosis are seen in the Dental Out-patient Department and Radiology Department of Institute of Medical Sciences Hospital, Varanasi, as also in the villages served by the Rural Training Centre of the Department of Preventive and Social Medicine. A preliminary study was, therefore designed with the objectives of estimating the prevalence of dental and skeletal fluorosis in the villages covered by the Rural Health Centre; and studying the level of fluoride in drinking water of the area under study and to correlate the prevalence of dental and skeletal fluorosis with fluoride content of drinking water.

Material and Methods

The study was carried out in Ledhupur and Rustampur villages belonging to the field practice area of the Rural Training Centre of the Institute of Medical Sciences, Varanasi. The combined population of these two villages was 3448 as recorded by house-to-house enumeration of these 3448 individuals, 150 to 160 were not examined as they were infants, leaving 3260 subjects who were more than one year of age. A total of 2159 individuals (approximately 70% coverage) were finally examined. Each of these individuals was subjected to clinical examination to detect dental fluorosis, skeletal fluorosis and genu valgum.

Presence or absence of dental mottling was noted and cases were labelled as Normal, Questionable, Very Mild, Mild and Severe as per criteria suggested by WHO¹⁰. Cases showing signs and

symptoms suggestive of skeletal fluorosis like chronic backache, pain in the cervical region, restricted joint movement, kyphosis, scoliosis *etc.* along with dental fluorosis were subjected to radiological investigation.

All the wells, *i.e.* 47 in Rustampur and 59 in Ledhupur were numbered and mapped. Water samples from one-third of the wells from each hamlet of the villages were drawn early in the morning and sent to the Department of Physiology, Institute of Medical Sciences, for the estimation of fluoride content.

Fluoride was estimated, after distilling the water samples with perchloric acid from a microstill at high temperature (135°C), colorimetrically by Zirconium-erychrome cyanine colour lake¹¹.

Results

No case of either skeletal fluorosis or genu valgum was detected on radiological investigation. The data here therefore pertain to dental fluorosis only.

Total number of persons showing dental fluorosis was 538 out of 2159 persons examined, giving a prevalence rate of 24.91 per cent (Table I). Prevalence of different grades of dental fluorosis was as follows: Questionable (Q)—311 (14.40%), Very Mild (VM)—121 (5.6%), Mild (M)—59 (2.73%) and Moderate (M)—47 (2.17%) respectively. There was not a single case of dental fluorosis of 'Severe' grade as defined by WHO¹⁰.

Prevalence of dental fluorosis was lowest in children of 1-5 yr age group (4.54%), followed by 6-10 yr (34.98%).

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Table I. Age-wise distribution of dental fluorosis in the study population

Age-group (yr)	Total no. of persons examined	Dental fluorosis cases				Total	Percentage prevalence
		Q	VM	M	Mod.		
1-5	396	14 (3·53)	2 (0·50)	1 (0·25)	1 (0·25)	18	4·54
6-10	463	100 (21·59)	33 (7·12)	13 (2·80)	16 (3·45)	162	34·98
11-15	234	68 (29·05)	40 (17·09)	13 (5·55)	13 (5·55)	134	57·26
16-20	157	37 (23·56)	15 (9·55)	11 (7·00)	6 (3·82)	69	43·94
21-25	152	26 (17·10)	16 (10·52)	8 (5·26)	3 (1·97)	53	34·86
26-30	146	21 (14·38)	3 (2·05)	8 (5·47)	4 (2·73)	36	24·65
31 above	611	45 (7·36)	12 (1·96)	5 (0·81)	4 (0·65)	66	10·80
Total	2159	311 (14·40)	121 (5·60)	59 (2·73)	47 (2·17)	538	24·91

Q, Questionable; VM, Very mild; M, Mild; Mod., Moderate; Percentages are shown in parentheses

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It was maximum in the age group 11-15 yr (57.26%). The prevalence rate of dental fluorosis beyond 15 yr gradually declined. There was highly a significant association between age and prevalence as analysed by means of X^2 test ($P < 0.001$).

The overall prevalence rate of dental fluorosis was significantly higher ($P < 0.001$) among males (30.4%) than among females (18.08%). There was almost no difference in the prevalence rate between males and females up to 15 yr of age but it was significantly lower ($P < 0.001$) among females beyond 15 yr of age (Table II).

Prevalence of dental fluorosis was significantly higher ($P < 0.001$) i.e. 40.95 per cent, among the villagers who were residing there since birth as compared to those who were immigrants in the village i.e. 4.24 per cent. The latter group com-

prised mainly females who immigrated to the village consequent to marriage.

The fluoride concentration of drinking water of different wells in this area ranged from 0.2 to 2.1 ppm. The mean fluoride level was, however, 0.9 ± 0.38 ppm. Thus, the level of fluorine was higher than the recommended permissible level (0.5 ppm) in Indian conditions¹².

The lowest prevalence of dental fluorosis (10.34%) was observed at the fluoride concentration of 0.5 ppm and below. Cases of dental fluorosis were seen with the minimum 0.2 ppm fluoride concentration in drinking water. The prevalence rate increased proportionately with the increase in fluoride concentration of drinking water and was highest (46.37%) at 1.5 to 2.1 ppm concentration. The difference in prevalence rates among persons consuming water with different concentration of fluoride was

Table II. Sex-wise and age-wise distribution of dental fluorosis

Age group (yr)	Male		Female	
	Examined	Dental fluorosis	Examined	Dental fluorosis
1-5	218	10 (4.58)	178	8 (4.49)
6-10	256	95 (37.10)	207	77 (37.19)
11-15	158	93 (58.86)	76	41 (53.94)
16-20	95	52 (54.73)	62	17 (27.41)
21-25	91	39 (42.85)	61	14 (22.95)
26-30	80	25 (31.25)	66	11 (16.66)
31 and above	299	50 (16.72)	312	16 (5.12)
Total	1197	364 (30.40)	962	174 (18.08)

Percentages are shown in parentheses

was statistically significant ($P < 0.001$; Table III).

The prevalence of dental caries was also recorded since the level of fluorine in water was optimum. In all, 1060 persons were seen suffering from dental caries out of the 2159 persons studied. Thus, the prevalence rate of dental caries was 49.10 per cent. However, no correlation between the level of fluorine and dental caries was observed.

Table III. Relationship between fluoride concentration in drinking water and dental fluorosis

Level of fluoride in water (ppm)	No. of persons consuming water	Persons having fluorosis dental
Up to 0.5	58	6 (10.34)
0.6 to 1.0	849	177 (20.85)
1.1 to 1.5	364	123 (33.79)
1.6 to 2.0	112	52 (46.43)
Above 2.0	26	12 (46.15)
Total	1409	370 (26.25)

Percentages are shown in parentheses

Discussion

The overall prevalence rate of dental fluorosis in the present study was 24.91 per cent. Different grades of dental fluorosis were as follows: Questionable-14.4 per cent, Very Mild-5.6 per cent, Mild-2.73 per cent and Moderate-2.17 per cent. Daver³ in his study, in three districts of Hyderabad where fluoride concentration in well water ranged from below 1 ppm to 5 ppm, observed chalkiness of

teeth in 16 per cent and mottled and pitted teeth in 21.7 per cent of the examined population. Krishnamachari¹³, on the other hand, observed that 70-90 per cent of population in 150 villages studied, had dental mottling. It may however, be observed that these villages were in the endemic zone of fluorosis with high level of fluorine in drinking water as compared to a fluorine content of 0.2 to 2.1 ppm in drinking water observed in the villages in the present study.

Prevalence of dental fluorosis increased with age and was highest between 11 to 15 yr of age, after which the prevalence rate declined. This observation is in conformity with the data of other workers^{2,6}. Daver³ also reported that the prevalence of fluorosis was more in children between 6-14 yr. Bagga and Mehta¹⁴, however, observed that dental fluorosis was more in persons over 15 yr than among those below 15 yr. The low prevalence of dental fluorosis in the 1-5 yr age group might be due to the fact that the deciduous teeth remain unaffected from environmental fluoride during formation in embryonic life, because the placenta is known to be only partially permeable to fluoride¹⁵. The decline in prevalence rate of dental fluorosis encountered beyond 15 yr of age though somewhat unexpected, might be due to the fading of the fluoride stain in teeth. Daver³ also contended that chalkiness might disappear after 30 yr of age, because of which prevalence was low beyond that age.

No difference of prevalence of dental fluorosis was observed between males and females up to the age of 15 yr whereas males showed a significant higher prevalence beyond 15 yr. Siddiqui^{4,9} reported

that both the sexes were affected with equal frequency. On the other hand, some other reports^{6,16,17} indicate that dental fluorosis is higher among males than females, this has been attributed to higher physical activity by male and hence higher consumption of water (and fluorine).

Prevalence of dental fluorosis was much higher among individuals residing in the two villages since birth than among the immigrants. The immigrant population mostly comprised females who had come to the study villages after marriage and probably were not exposed to the high fluorine level in water during their childhood. This could also be the reason for lower prevalence of dental fluorosis in women of age 15 yr and above as compared to men of same age groups.

In the present study, a positive association of prevalence rates of dental fluorosis with the level of fluoride in drinking water was observed, as has been seen by several other workers and points to the fact that the single most important factor which determines fluoride toxicity is the concentration of fluoride in drinking water^{2-4,6}.

Acknowledgment

The authors are grateful to the Indian Council of Medical Research, New Delhi, for providing financial support for this study.

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Reprint requests : Dr S.K. Ray, 6A, Monmatha Bhattacharjee Street
Calcutta 700004