

Estimation of Fluoride Level in Drinking Water and Prevalence of Dental Fluorosis in Vairag Village of Solapur District, Maharashtra, India: A Cross Sectional Study

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Abstract

Introduction: Dental fluorosis occurring due to drinking water with high concentration of fluoride is a common public health problem in India. Hence the present study was designed with an aim to estimate fluoride levels in drinking water source of the people from Vairag village and to determine the prevalence of dental fluorosis among residents of Vairag village.

Materials and Methods: It was a cross sectional study conducted on residents of Vairag village of Solapur district in Maharashtra state. Drinking water source was analyzed for fluoride content by specific ion meter method. Dental fluorosis was assessed in 950 subjects using Community Fluorosis Index. Water samples from 4 different sources were analyzed for fluoride level. Data obtained was subjected to descriptive statistics.

Results: The fluoride concentration in the water samples collected ranged from 0.64-7.8 ppm. Of 950 subjects studied, 149 (15.68%) subjects suffered from various grades dental fluorosis. Community fluorosis index was found to be 0.354.

Conclusions: Though we found subjects suffering from dental fluorosis in Vairag village (15.68% prevalence), it can be considered as a public health problem (according to CFI value 0.354).

Keywords: Community fluorosis index; Dental fluorosis; Fluoride; Water

Introduction

Fluoride has always been considered as a “double edged sword”. The optimum and judicious use of fluoride has resulted in caries protection whereas injudicious use has resulted in chronic fluoride toxicity, which manifests as dental and skeletal fluoride [1]. Dental fluorosis is an endemic disease occurring in people who consume water having fluoride concentration more than normal levels (1.0-1.5 ppm) at the time of tooth formation [2,3]. Fluorotic lesions are usually bilaterally symmetrical and clinical features of dental fluorosis range from few minute white flecks or spots to brown stains with pits on teeth [4]. Children in the age group of 1-12 years are more prone to development of fluorosis since their body tissues are in formative or developmental stage during this period.

Endemic fluorosis is considered to be a major public health problem worldwide as well as in India. More than 60 million people are exposed to risk of fluorosis due to high concentration of fluoride in drinking water [5]. Almost 230 districts of 19 states in India are endemic for dental and skeletal fluorosis, Maharashtra, being one of the affected

states [6]. Available literature shows that many areas in Maharashtra state are affected due to problem of fluorosis; major reason being consumption of water having high concentration of fluoride in the range of 0.8-10 ppm [7-9]. Hence the present study was undertaken with an aim to estimate the fluoride concentration in drinking water in Vairag Village of Solapur district of Maharashtra, India and to determine the prevalence of dental fluorosis in residents of Vairag village.

Material and Methods

The present study was across sectional study conducted among 950 residents of Vairag village, Solapur district of Maharashtra state. Permission to conduct the study was obtained from Sarpanch of Grampanchayat of Vairag village. Ethical clearance was obtained from Institutional Ethical Committee. All the residents were explained about the objectives of the study and informed consent was obtained from them. All the included subjects in the study group were local residents and those who were residing there since birth. Subjects who consumed drinking water from more than one source and married females and those not native of Vairag were excluded from the study.

Clinical examination

All the subjects were examined under natural light. Type 3 examinations were followed for screening of subjects. Instruments were disinfected with an antiseptic solution after every use. Single examiner performed all the examination procedure in this study so as to maintain consistency and to eliminate inter examiner bias. Recording was done by another person who assisted the examiner in recording the details. Assessment of dental fluorosis was done using Community Fluorosis Index. The recording was made on the basis of the two teeth that are most affected. If the two teeth were not equally affected, the score for the less affected of the two was recorded [10].

Sources and analysis of drinking water for fluoride content

Community water supply system except in three areas viz. Shivajinagar, Dattanagar and Ghongade plot which are supplied by bore water. Hence one sample of tap water and one sample each of bore water from above mentioned areas were collected in clean and sterile plastic bottles, which were doubly rinsed with distilled water. They were labeled, coded and sent to a private laboratory for fluoride estimation. Fluoride level in water samples was analyzed using fluoride

ion selective electrode method. Data obtained was subjected to descriptive statistics using SPSS 16 software.

Results

The fluoride concentration in the tap water sample was 0.64 ppm, whereas fluoride concentration in three different bore water samples was 7.8 ppm, 3.42 ppm and 7.1 ppm respectively (Table 1). Of 950 subjects studied, 149 (15.68%) subjects suffered from various grades dental fluorosis (Table 2).

Sample	Fluoride concentration (in ppm)
Sample 1 (Tap water)	0.64
Sample 2 (Bore water)	7.8
Sample 3 (Bore water)	3.42
Sample 4 (Bore water)	7.1

Table 1: Fluoride concentration (in ppm) in drinking water samples.

Total Sample (N)	Number of affected cases (Prevalence of dental fluorosis)	No. of cases with Positive family history of dental fluorosis
950	149 (15.68%)	35 (23%)

Table 2: Prevalence of dental fluorosis among study participants.

Amongst positive cases, 35 subjects (23%) had positive family history of dental fluorosis (Table 2). Out of 149 subjects, 128 subjects (85%) had their permanent teeth affected due to fluorosis, whereas 21 subjects (15%) has their primary teeth affected (Table 3). One hundred five subjects (70%) had their anterior teeth affected while 18 subjects (12%) had posterior teeth affected and 26 subjects (18%) had both primary as well as permanent teeth affected (Table 3).

Type of teeth affected	No. of teeth affected
Permanent teeth	128 (85%)
Primary teeth	21 (15%)
Anterior teeth	105 (70%)
Posterior teeth	18 (12%)
Both anterior and posterior teeth	26 (18%)

Table 3: Pattern of teeth affected by dental fluorosis.

Age Group	No. of cases affected
1-10 years	48
11-20 years	88
21-30 years	6
31-40 years	4
41-50 years	2
51 years and above	1

Total	149
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Table 4: Age-wise distribution of dental fluorosis.

Most affected age groups were 11-20 years (88 subjects) and 1-10 years (48 subjects) out of 149 cases (Table 4). Among dental fluorosis affected population, 49 (33%) were affected with mild grade fluorosis, 41 (28%) were affected with moderate grade fluoride, 28 (19%) were affected with very mild grade fluorosis, 21 (14%) were affected with severe grade fluorosis and 10 (6%) were affected with questionable grad fluorosis (Table 5). Community fluorosis index was found 0.354 which denotes "negative" category of public health significance (Table 5).

Grade	No. of cases affected	CFI Score
Normal (0)	801	0
Questionable (0.05)	10	0.005
Very mild (1)	28	0.029
Mild (2)	49	0.103
Moderate (3)	41	0.129
Severe (4)	21	0.088
Total	950	0.354

Table 5: Distribution of study subjects according to Community Fluorosis Index (CFI).

Discussion

Fluoride concentration in groundwater of some villages in Maharashtra state varied from 0.8-10 ppm causing dental fluorosis among people of these villages [7-9]. Similar findings were obtained in the present study with fluoride concentration in drinking water samples ranging from 0.64-7.8 ppm causing dental fluorosis among the residents of the village.

On the basis of clinical presentation, the dental fluorosis was observed with varying grades of discoloration of teeth ranging from chalky white flakes to brownish corroded stained with pitting appearance of teeth. Similar findings were observed in a study conducted by Marganwar et al. [8]. The overall prevalence of dental fluorosis in the present study was 15.68%, which is less as compared to other studies conducted in different villages of Maharashtra state [7-12]. However, one such study conducted in Himachal Pradesh reported a low prevalence of dental fluorosis (4.1%) [13]. This finding of low prevalence is attributed to less consumption of ground water for drinking purposes and supply of treated water for household consumption has increased as per revised guidelines of the Central Government.

Prevalence of dental fluorosis was found more in the subjects belonging to age group of 11-20 years of age (59%) followed by subjects in 1-10 years of age (32%) as compared to old age people. The findings are in accordance with the studies conducted by Kotecha et al. [14], Bhat and Kumar [15]. Permanent teeth (85%) were affected more than primary teeth (15%) in the present study. This disparity may be due to the fact that much of the mineralization of primary teeth occurs before birth and the placenta serves as a barrier for the transfer of high concentration of plasma fluoride from pregnant mother to developing fetus, thus controlling the delivery of fluoride to the developing primary dentition. Whereas mineralization of permanent teeth start at birth and continues till the age of 5 years, except in third molars. Hence they are more affected due to high concentration fluoride which is easily available through drinking water [16]. Other reasons for lower prevalence in the younger age groups may be that the period of enamel formation for primary teeth is shorter and hence the exposure to fluoride is shorter and the enamel of primary teeth is thinner than that of permanent teeth [16]. Also rapidly growing skeleton of fetus may absorb fluoride at more rapid rate since fluoride is a hard-tissue seeker and is thus less available for primary teeth [17].

Conclusion

It can be seen from the results that there are cases of fluorosis in Vairag village, though prevalence of dental fluorosis is low. But considering the defects seen on teeth and the negligence of the people in relation to drinking water source, it definitely requires a public awareness campaign so as to change the drinking water source. Active steps should be taken to partially defluoridate the water before distribution to reduce the morbidity associated with dental fluorosis in

affected areas. Similar surveys are required in other parts of Solapur district to identify areas with high water fluoride content and determine the extent and manner in which defluoridation can be carried out.

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