Research Article

Correlation between fluorosis and dental caries in endemic areas of Wardha district

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ABSTRACT

Background: Endemic fluorosis resulting from high fluoride concentration in groundwater is a major public health problem in India. **Objectives:** This study was carried out to measure and compare the prevalence of dental fluorosis and dental caries in the population residing in the high and normal level of fluoride in their drinking water in Wardha district, Maharashtra, India. **Materials and Methods:** The Institutional Ethical Approval for the study was obtained before starting the study. Written consent was obtained from the principal of the school and parents of students for the dental evaluation. This is a cross-sectional study for 2 months at two different endemic fluorosis areas of Wardha district for the evaluation of prevalence of dental fluorosis and dental caries in school-going children. **Results:** Level of fluoride in drinking water at two different was 1.9 ppm and 2.5 ppm, respectively. All the students were examine for dental fluorosis and dental caries, and the data were collected and tabulated for analysis. **Conclusion:** In present study, 1100 school-going children were studied. The prevalence of dental fluorosis in the study population was 20.09%, and the prevalence of dental caries was 26.4%. The severity of dental fluorosis increased and prevalence of dental caries decreased with increasing the fluoride level in drinking water.

KEY WORDS: Drinking Water Endemic Fluorosis; Dental Caries; Dental Fluorosis

INTRODUCTION

Endemic fluorosis resulting from high fluoride concentration in groundwater is a public health problem in India. Fluorine is the most abundant element in nature, and about 96% of fluorine in the human body is found in the bones and teeth.[1] Fluorine is essential for the normal mineralization of the bones and formation of dental enamel. The principal sources of fluorine were drinking water and food such as seafish, cheese, and tea.[2] The disease starts as chalky white spots, which later turns to brown.

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The recommended level of fluoride in drinking water in India is 0.5-0.8 mg/l.[3] The available data suggest that 15 states in India are endemic for fluorosis including some district of Maharashtra (fluoride level in drinking water >1.5 mg/l) and about 62 millions are children below the age of 14 years.[4] Groundwater is the major source of drinking water in most of the places.[5] The estimated range of safe and adequate intake of fluorides for adults is 1.5-4.0 mg per day, and it is less for children. In endemic regions, daily intake of fluoride varies from 10 to 35 mg and can be even higher in summer months. The adverse effects of fluoride include dental fluorosis and skeletal fluorosis, and it has effects on red blood cell wall. Dental fluorosis mainly involves enamel, but severe intoxications may affect dentine as well as pulp. As the affected teeth lose their normal, creamy, white translucent color and become rough, opaque, and chalky white.[6]

This study is to measure the prevalence of dental fluorosis and dental caries in the population residing in an area with

a high and normal level of fluoride in drinking water and to find whether high fluoride level in drinking water is more protective for dental caries or a risk factor for dental fluorosis. The water supply of endemic area in Wardha district selected for the study reported that the level of fluoride is more than 1.5 mg/l.

In India, few researches have been carried out in fluorosis affected areas to see the gravity of the problem and reason behind it.

According to a study conducted in Southern Rajasthan, India, by Choubisa in 2001, both children and adults were suffering with dental fluorosis at 1.5 ppm fluoride level. It was found that maximum prevalence of dental fluorosis (77.1%) was in the 17-22 years of age group. At 1.5 ppm fluoride level, only adults were suffering with skeletal fluorosis. The prevalence of skeletal fluorosis was higher in males, and it increased with age and higher fluoride level. In higher age group (>40 years) at a fluoride concentration of 2.8 ppm or higher, deformities such as crippling, kyphosis, and genu varum were observed.[7]

In Maharashtra, a study conducted by Rawlani in 2010[6] mentioned that the prevalence of dental fluorosis in Vidharbha area ranges from 43.13% to 56.87%.

Another study conducted by Rawlani in 2011[8] suggested that the prevalence of dental fluorosis in Wardha district of Maharashtra is 16.5%.[8]

The study conducted at Tamil Nadu by Murugan et al., 2011, explained percentage prevalence of fluorosis, the age- and sex-specific incidences of dental fluorosis, and the inhibitory role of fluoride on various blood components. The findings revealed that the percentage prevalence of fluorosis in the study population was 17.1%, the age- and sex-specific incidences of dental fluorosis in males was 21.42% and in females 19.98%, and the inhibitory role of fluoride on various blood components - "B" and "O" blood group individuals were found more vulnerable to water fluoride intoxication than "A" and "AB" blood group people.[9]

A study conducted by Harikumar et al. 2007 at Northwest district of Tamil Nadu noted that 126 water samples collected from seven of thirteen villages contained more than the WHO cutoff level of 1.5 ppm fluoride. The prevalence of dental mottling was high among children (5-14 years) in Dharmapuri (53%), Krishnagiri (43%), and Salem (42%) district.[10]

In 2008, Yadav et al. carried out a research article titled "Fluoride distribution in groundwater and survey of dental fluorosis among school children in the villages of the Jhajjar district of Haryana, India." The study revealed that fluoride content in underground water was different in different villages. The school-going children (7-15 years) showed different type and stage of dental fluorosis as per fluoride concentration in drinking water.[11]

The Regional Medical Research Center for Tribal Jabalpur in 2004 conducted a study in Mandla district of Madhya Pradesh under Chakma and Vinay, which revealed a high prevalence of genu valgum (51.1%) and dental fluorosis (74.4%). Water analysis revealed high fluoride content (9-13 ppm) in few villages.[12]

In 2008, Kotoky et al. carried out research in Karbianglong district of Assam. The study revealed that 100,000 people of the 700,000 population were suffering with dental or skeletal fluorosis or both and high concentrations of fluoride were found in some areas such as Ramsapather (>20. 6 mg/l) and Lungnit (>15.4 mg/l).[13]

In 2009, research carried out by Raju et al., in Sonbhadra district, Uttar Pradesh, to assess fluoride concentration in groundwater. The research revealed that concentration of fluoride varies from 0.483 to 6.7 mg/l in geological area of the study. Previous studies mention that, due to high consumption of fluoridated water there are skeletal changes in the form of deformation of ligament, bending of spinal column, thicken outer/inner table of skull bone and barrowing of the long bone along with dental changes.[14]

In 2010, a cross-sectional study was carried out by Pandey in Gureda village, Drug district of Chhattisgarh. The inference drawn from the study was that the prevalence of dental fluorosis was 8.2%. Dental fluorosis was higher in the 8-45 age groups. In males, both skeletal and dental fluorosis was more common, and the prevalence of skeletal fluorosis increased with age. The most common skeletal deformities found were genu varum (38.1%) and genu vulgum (6.3%). The level of water fluoridation ranges from 0.2 to 7.8 ppm.[15]

The study was conducted on the basis of iron selective electrode method by Sahu et al., 2006 at BALCO, Korba region and confirmed that the groundwater samples of 34 villages of this region had fluoride concentration values ranging from 1.07 to 3.10 ppm and villagers were found suffering with dental and skeletal fluorosis.[16]

All these studies suggest that groundwater contains high fluoride concentration and consumption of fluoride-containing water (i.e., more than 1.5 mg/l fluoride) for longer duration is hazardous to human health and is a major public health problem in some part of India.

This study was aimed to test the hypothesis whether high fluoride level in drinking water is more a risk factor leading to fluorosis than in protective role in the prevention of dental caries and the severity of dental fluorosis and dental caries among the school going children of Wardha district.

MATERIALS AND METHODS

The institutional ethical approval for the study was obtained before starting the study. Written consent was obtained from the principal of the school and parents of students for the dental evaluation.

This is an observational study for 2 months at two different endemic fluorosis areas of Wardha district, i.e., Ajanti and Kawalghat for evaluation of the prevalence of dental fluorosis and dental caries in school-going children's.

Inclusion Criteria

The following children were included in the study:
- School going children of endemic fluorosis areas.
- Children those who are resident of same village.

Exclusion Criteria

The following children were excluded from the study:
- Medically compromised children.
- Children coming from other village to study.

Sample Size: 1100

- Water samples were collected from all the water sources.
- Oral examination of children was carried out in a bright daylight.
- Dean's index and Decay, missing and filled teeth (DMFT/DMFT) index calculated.

Dental caries care was counted when any of the teeth falls into the category of decayed, missing (due to caries) and filled teeth (DMFT-Index).

Fluorosis prevalence is determined by whether or not the child had at least two teeth scored with fluorosis of Dean's score.

Dental fluorosis when the tooth was not normal, the grading for dental fluorosis was done using Dean's fluorosis index.

Grading of fluorosis

Type	Score
Normal	0.0
Questionable fluorosis	0.5
Very mild fluorosis	1.0
Mild fluorosis	2.0
Moderate fluorosis	3.0
Severe fluorosis	4.0

Classification of Dental Fluorosis Severity Degree According to Dean's Fluorosis Index

- Questionable: Slight defects of translucent normal dental enamel ranging from several white tiny specks to occasional white stains.
- Very mild: Tiny non-transparent white specks scattered randomly and irregularly on the tooth surface and covering <25% of the tooth surface.
- Mild: Areas with white stains on the enamel covering from 25 to 50% of the tooth surface.
- Moderate: The tooth surface is prone to the marked erasure with frequent brown stains of irregular shape.
- Severe: All tooth enamel surfaces are affected. Extremely marked hypoplasia that can change the entire tooth form. Isolated or confluent pits are the most basic diagnostic sign of this code. Brown stains occur frequently. One can get an impression that a tooth is attacked by the corrosion.

Score for Dental Caries

- D/d: Decayed tooth/teeth in permanent and deciduous dentition.
- M/m: Missing tooth/teeth due to caries in permanent and deciduous dentition.
- F/f: Filled tooth/teeth in permanent and deciduous dentition.

RESULTS

Level of fluoride in drinking water at two different was 1.9 ppm and 2.5 ppm, respectively. All the students were examined for dental fluorosis and dental caries, and the data were collected and tabulated for analysis in Figure 1 and Table 1-3.

Table 1: Severity of dental fluorosis

Severity of dental fluorosis	Percentage
No fluorosis	79.91
Questionable	0.4
Very mild	9.3
Mild	7.09
Moderate	2.72
Severe	0.4

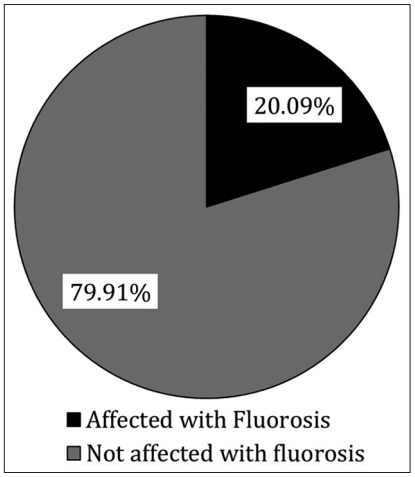

Figure 1: Prevalence of dental fluorosis

Table 2: Prevalence of dental caries

Number of students	1100 (%)
Caries	291 (26.4)
No caries	809 (73.6)

Table 3: Fluorosis and caries level of two villages

Name of village	Ajanti (2.5 ppm)	Kawalghat (1.9 ppm)	*P*
Dental fluorosis (%)	154 (33.8)	81 (12.7)	0.01 (S)
Dental caries (%)	20 (4.4)	271 (42.1)	0.4 (NS)

P<0.05 which is significant, NS: Not significant, S: Significant

DISCUSSION

In the present study, 1100 school-going children were studied. The prevalence of dental fluorosis in the study population was 20.09% (total 235 students), and the prevalence of dental caries was 26.4% (total 291 students). All the students are having mild fluorosis, and this percentage increased with increasing water fluoride level. Of 20.9% of affected students, 0.4% are questionable fluorosis, 9.3% are very mild fluorosis, 7.09% are mild fluorosis, 2.72% are moderate, and remaining 0.4% are having severe fluorosis.

Black, in May 1916, firstly reported the relationship between fluoride and dental caries and in the early 20th century about brown stains on teeth.[17] These stained teeth were highly resistant to dental decay. Dental fluorosis develops only when one is exposed to high fluoride level during 0-6 years of age when dentition develops. Once fluorosis develops, it is permanent. A various study conducted to find the prevalence of dental fluorosis shows the same type of results. Choubisa in 2001[7] had reported the prevalence of dental fluorosis as 45% among 21 different villages in Southern Rajasthan. Another study conducted by Bawaskar and Bawaskar in 2006 in a villages of Maharashtra had found the prevalence of dental fluorosis as 43%.[18] In Maharashtra, a study conducted by SudhirRawlani[6] in 2010 mentioned that the prevalence of dental fluorosis in Vidharbha area ranging from 43.13% to 56.87%.[7] Another study conducted by Rawlani in 2011 suggested that the prevalence of dental fluorosis in Wardha district of Maharashtra is 16.5%.[8] This value favors the results of the present study.

Alternatively, we restricted the analysis to those who were staying in the same villages since birth. For reanalysis, the study population was excluded for those who have not been staying in the respective villages from the birth. The difference in dental caries decreased while difference in dental fluorosis increased, justifying the need for removing the confounder in the analysis. The crude and age- and sex-adjusted relative risk also increased for dental fluorosis for high fluoride area. Further, it also indicates that fluoride in water is more a risk factor for fluorosis than a protective factor for dental caries.

CONCLUSION

In human nutrition, fluorine plays a dual role, to prevent dental caries at a certain level of intake and can cause serious damages in bony and dental tissues. The severity of dental fluorosis increased and prevalence of dental caries decreased with increasing the fluoride level in drinking water.

REFERENCES

1. Park K. Park's Text Book of Preventive and social Medicine. 21st ed. Premnagar, Jabalpur, India: Banarasisdas Bhanot Publishers; 2011. p. 577.
2. Passmore R, Nicol BM, Rao MN, Beaton GH, Demayer EM. Hand book on human nutritional requirements. MonogrSer World Health Organ. 1974;61:1-66.
3. Jolly SS, Singh ID, Prasad S, Sharma R, Singh BM, Mathur OC. An epidemiological study of endemic fluorosis in Punjab. Indian J Med Res. 1969;57(7):1333-46.
4. Susheela AK. Fluoross: Indian scienario: A treatiseon Fluorosis. New Delhi, India: Fluorosis Research and Rural Development Foundation; 2001.
5. Brindha K, Elango L. Fluoride in groundwater: Causes, implications and mitigation measures. In: Monroy SD, editor. Fluoride Properties, Applications and Environmental Management. New York: Nova Publishers; 2011. p. 11-136.
6. Rawlani S, Rawlani S, Rawlani S. Assessment of skeletal and non- skeletal fluorosis in endemic fluoridated areas of vidharbha region, India: A survey. Indian J Community Med. 2010;35(2):298-301.
7. Choubisa SL. Endemic fluorosis in southern Rajasthan, India. Int Soc Fluoride Res. 2001;34(1):61-70.
8. Rawlani SM, Bhowate R, Motwani M, Degwekar S, Rawlani S, Chandak RM. Clinical, Haematological, biochemical and radiological assessment of dental fluorosis in endemic fluoridated area of Maharashtra, Indian. J Indian Acad Oral Med Radiol. 2011;23(4):163-7.
9. Murugun A, Subramanian A. Studies on dental fluorosis in low fluoride areas in the southernmost part of India. Aust J Basic Appl Sci. 2011;5(11):329-33.
10. Hari AK, Khandare AL, Brahmam VN, Venikah K, Gal CH, Sivkumar B. Assessment of current status of fluorosis in north-west district of Tamil Nadu using community index for dental fluorosis. J Hum Ecol. 2007;21(1):27-32.
11. Yadav PJ, Suman L, Sudhir KK, Sunil K. Fluoride distribution in ground water and survey of dental fluorosis among school children in the villages of the Jhajjar district of Haryana, India. Environ Geochem Health. 2009;31:431-8.
12. Chakma T, Vinay PR. A Biannual Newsletter of Regional Medical Research Center for Tribals, Jabalpur. Vol. 1-2. Jabalpur: The Director, Regional Medical Research Centre for Tribals (ICMR); 2004.
13. Kotoky P, Barooah PK, Baruah MK, Goswami A, Borah CG,

Gogoi HM, et al. Fluoride and endemic fluorosis in the karbianglong district, Assam, India. Res Rep Fluoride. 2008;40(1):42-5.
14. Janardhana NR, Sangita D, Kaushik D. Fluoride contamination in ground water of sonbhadra district, Uttar Pradesh, India. Curr Sci. 2009;96(7):979-85.
15. Pandey A. Prevalence of fluorosis in an endemic village in central India. Trop Doct. 2010;40(4):217-9.
16. Sahu A, Vaishnav MM. Study of fluoride in ground water around the BALCO, Korba area (India). J Environ Sci Eng. 2006;48(1):65-8.
17. Black GV. An investigation of mottled teeth: An Endemic Developmental Impertion of the Enamel of the Teeth, Heretofore Unknown in the literature of Dentistry. Dent Cosmos. 1916;58:477-84.
18. Bawaskar HS, Bawaskar PH. Endemic fluorosis in an isolated 10. Village in western Maharashtra, India. Trop Doct. 2006;36:221-3.

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