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Fluorosis - An Ongoing Challenge For India

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ABSTRACT: In rural areas where people don't have access to treated drinking water, prolonged intake of fluoride can affect teeth, bones and major joints, including the neck, back, hips, and knees, reducing mobility. As the bones grow stiffer, the condition becomes increasingly painful and can lead to permanent disability.

Known as skeletal fluorosis, this disease has been widely studied for decades, but according to the Fluoride Knowledge and Action Network, "for a problem of this scale, the response has still been very patchy at the national level".
The Government of India says that as of April, 2014, fluoride prevalence was reported in 230 districts in 19 Indian states, with 14 132 homes in the risk areas still lacking safe drinking water. The population at risk is officially estimated to be around 11·7 million, although NGOs warn that the threat is much more widespread, affecting over 60 million people nationwide.
India has a national programme for the prevention and control of fluorosis that started in 2009. Over the years, the plan has targeted nearly 200 districts in 17 states with increased diagnostic activities, treatment, and rehabilitation at a village and district level. In the early 2000s the government's response also involved installing defluoridation plants in areas at risk such as the desert state of Rajasthan, where to date over 4 million people are still affected by fluorosis.
However Nanak Santdasani, WASH Officer with UNICEF in Rajasthan, says that water purification alone is not the solution. "During our research, we found that skeletal fluorosis is not always irreversible as previously thought", he says. "If we combine access to safe water with nutrition supplements and health services, we can reverse the condition in children younger than 12." Santdasani's integrated fluorosis mitigation was initially met with some scepticism but, after being trialled in Bihar and Rajasthan, it was eventually accepted as an effective response strategy.

KEYWORDS: fluorosis, rural India, government, national programme, water purification, health services

I.INTRODUCTION

The notion that some patients can be successfully treated or even cured, reversed decades of convention among the medical community. In 2016, Susheela notes that "the message that the disease has "no treatment or cure" was deeply ingrained in the perception of the medical fraternity. The disease was thus totally neglected." At the time, the study adds, "no patient with fluorosis was admitted to a hospital for fear of blocking a bed."
Vikas Ratanjee, advocacy manager with the India Natural Resource Economics and Management (INREM) Foundation, acknowledges the efforts made by the government over the years, but notes how India's looming water crisis represents an unexpected setback.[1,2]

India is an agrarian country, with 60% of its land used for agriculture, and, as the economy grows, farmers are expected to feed a growing population as well as continue to increase exports. Over the years, this has increased the need for water for irrigation and, in the absence of stringent regulations, fresh water resources have been overexploited across the country.[31,32]

In 2015, a study used satellite data to estimate trends in global freshwater availability, identifying India as a major hotspot of water depletion, despite a slight increase in expected precipitation in the coming years. But as climate change alters monsoon patterns in the subcontinent, certain areas are expected to experience more drought, forcing people to dig deeper into the ground to find water to drink. "This is where water tends to be more contaminated, so if we are not vigilant the fluoride epidemic will get worse before it gets better", Ratanjee says. "After several decades since it was identified, the unfettered extraction of groundwater has only exacerbated the issue of fluoride poisoning, and so far there are no signs of abatement."[3,4]

Last year, the government renewed its push towards better water management across the country by setting up a new ministry of water, the Jal Shakti, and a new initiative, the Jal Jeevan Mission, with a goal to provide piped drinking water to every rural household in India by future. If successful, the mission will achieve in just 5 years a goal that has remained out of reach since Indian independence in 1947, drastically curbing the issue of skeletal fluorosis as well as

other forms of water poisoning that are still rife in India. “The government's efforts are promising”, Ratanjee says, “but efforts need to [be] sustain[ed].”[29,30]

In all major cities, people have access to clean water—whether it is bottled, or purified at home with reverse osmosis filters. “Not everybody drinks contaminated water”, Susheeta says, “and yet they also suffer from fluorosis. So our question is, what are the other sources of fluoride intake?”
Consumption through food is more difficult to estimate because it comes from myriad sources, and when it leads to toxicity doctors struggle to diagnose it. [5,6]According to Susheeta, rock salt, a staple of Indian diets, is at least partly to blame, although organisations such as UNICEF say that the salt is not toxic and should just be avoided if a patient is already affected by fluorosis. Several studies have identified a strong correlation between the accumulation of fluoride in the body and mild-to-moderate anaemia. The Indian National Health portal recommends supplements and iron rich foods such as beans, meat, and raisins, but as fluoride hampers the ability of the digestive systems to absorb nutrients, a good diet and supplements prescribed by doctors are insufficient to solve the problem.[27,28]

A growing body of research is now placing greater focus on eliminating excess fluoride from diets rather than replacing missing nutrients with supplements. UNICEF recommends helping people identify safe water sources and promotion of kitchen gardens with plants such as tamarind or guava, that help decrease fluoride absorption. And while promoting dietary changes is a tough battle, especially in a country with ancient food traditions like India, both Susheeta and Santdasani agree that raising awareness among pregnant women may be the best starting point, because they are more at risk and want their babies to be healthy. In addition to advocacy work at a community and political level, “a targeted social media campaign would go a long way,” says Santadasani, “because even in rural areas everyone now has a phone with good signal.”

According to Susheeta, long-term goals should never fall off the radar, especially when it comes to maternal health: “When pregnant women consume fluoride they are not able to absorb iron and other supplements that they are provided with in antenatal clinics,” she says, “so they often become nearly anaemic, delivering small babies or risking their lives.” High infant and maternal mortality are particularly devastating for the country, she warns.
Dental fluorosis is one among the major public health problems in many parts of the world including India. Since its first reporting as “mottled enamel” by Fredrick McKay, dental fluorosis is extensively described by investigators as the visible sign of chronic fluoride toxicity.[13] Endemic dental fluorosis is caused by the excessive ingestion of fluorides (>1 ppm) due to the contamination of soil, air and water.[14],[15]

Dental fluorosis is a developmental condition having a dose-response relationship. The severity of dental fluorosis is dependent on the quantity and timing of fluoride ingestion during developmental period.[16]
The clinical appearance of the teeth vary from barely noticeable changes to an ugly brown stain with more pronounced pitting and loss of architecture.[17]
Ground water has been a significant source for domestic consumption, irrigation and industrial use in India. More than 85% of rural and 50% of urban domestic water requirements is met from ground water resources.[18] As Haryana is a major endemic fluoride area where ground water fluoride concentration is high, there is scarcity of data regarding prevalence of dental fluorosis and treatment needs. Hence, the present study was conducted.[7,8]
Our study revealed that most of the children were diagnosed with TFI score 2, 3, 4 and 5 categories (Equivalent to mild to severe degree of dental fluorosis according to modified Dean's Fluorosis Index (1942).[19] 44.8% of children had a score of TFI ≥ 4 which was characterized by brown staining and opacities covering more than 50% of tooth structure. In our study, 11.6% had questionable or very mild fluorosis (19.2%); and 21.0% had mild (26.1%), moderate (12.1%), and severe (6.6%) fluorosis.
Milder form of dental fluorosis was more common than its severe form and similar results were found by Aguilar-Diaz et al.[20] Onoriobe U, et al.[21] Tellez M, et al.[22] and in contrast to study conducted by Do LG, et al.[23]
The fluoride concentration in the present study ranged from 0.23 ppm to 25.7 ppm which was directly proportional to the TFI scores. Majority of the school children at present used purified tap water for drinking purpose but consumed ground water with increased concentration of fluoride during their developmental stages and this may be the reason for occurrence of dental fluorosis. The Government of Haryana has made provision of supply of tap water to most of the villages which have reduced the risk of dental fluorosis.[26]
Our study revealed that the prevalence of dental fluorosis was 96.6%. Similar results were found by Vuhahula et al.[24] in Tanzania. In a similar study conducted by Mann et al.[25] prevalence of dental fluorosis was found to be 100%. In another study conducted by Onoribe U, et al.[21] it was found that 28.2% of the children were affected by fluorosis; which was similar to the study conducted in Kanpur, Uttar Pradesh (18%.)[26] As Haryana is one among the endemic fluoride areas in India, the prevalence of dental fluorosis ranged from 30% to 94.85% in the high-fluoride villages and from 8.80% to 28.20% in the low/normal-fluoride villages.[10],[27],[28]

The data from present study revealed that prevalence of moderate to severe dental fluorosis (TFI 4 to 8) among the female subjects was found to be higher than their male counterparts. This finding is in contrast with the studies conducted by Khan SQ, et al.[29] Kotecha PV, et al.[30] In the present study around 30.8% of children fell in the categories of TFI scores (1, 2) who required bleaching of their teeth. Around 47% of children having mild to moderate fluorosis (TFI scores 3, 4) required microabrasion on their teeth and this may be followed by bleaching by sodium hypochlorite or carbamide peroxide. Satisfactory results were obtained in study conducted by Gupta et al.[31] Penumatsa NV, et al.[32] Those children effected by severe dental fluorosis can be managed by giving laminates/veneers or crown. The present study used TFI index for measuring the level of dental fluorosis which can be used to measure wide spectrum of dental fluorosis in epidemiological surveys.[9,10]

II.DISCUSSION

Fluorosis is one of the severe public health problems in India, as almost two-third states are fluoride endemic .In India, approximately 25 million people are presently affected by fluorosis and 66 million are at risk of developing fluorosis, including children of age 14 years [2]. India is situated in the geographical fluoride belt and in areas where fluoride content is high in rocks or soil, leaching of fluoride occurs, causing excess fluoride level in groundwater. However, the level of fluoride in water also depends on the natural solubility, presence of other minerals, the acidity of the soil and amount of water present, which explains high fluoride content in the groundwater [3].Drinking water is the prime dietary source of fluorides. In addition, fluoride can also be present in foods such as salt water fish, sorghum, finger millets and crops grown in soil irrigated by water containing a high concentration of fluorides [4, 5]. Though, fluoride is an essential element for bone and teeth development as it forms hydroxyapatite with the calcium present in them and approximately 99% of the fluoride is found in calcified tissues of human body [5], and optimum fluoride level in diet prevent from dental caries, but high fluoride level exposures for a prolonged period results in dental fluorosis, skeletal fluorosis, and decrease in intelligence quotient [5–8].Karnataka is one of the fluoride endemic states in India and 13 districts, including Kolar district, located in the eastern and south-eastern belt of Karnataka have reportedly high level of fluoride in the groundwater. However, limited studies have been done on the burden of dental fluorosis among these districts of Karnataka. Therefore, a school-based cross-sectional study was undertaken to quantify the prevalence and severity of dental fluorosis and to find the factors associated with dental fluorosis among the school going adolescents. The present study has some limitation of cross-sectional nature of this research. Further data regarding diet history was not taken which might affect the prevalence of dental fluorosis because vegetables grown in endemic fluoride area also affects the dental fluorosis. Considering the mentioned limitations, further research is required in this field.[10,11]

III.RESULTS

National Programme for Prevention & Control of Flurosis (NPPCF)

Fluorosis, a public health problem is caused by excess intake of fluoride through drinking water/food products/industrial pollutants over a long period. It results in major health disorders like dental fluorosis, skeletal fluorosis and non-skeletal fluorosis.

Problem: Dental Fluorosis affects children and discolours and disfigures the teeth. The teeth could be chalky white and may have white, yellow, brown or black spots or streaks on the enamel surface. Discoloration is away from the gums and bilaterally symmetrical. Skeletal Fluorosis affects the bones and major joints of the body like neck, back bone , shoulder, hip and knee joints with severe pain, rigidity or stiffness in joints. In severe forms results in marked disability. NonSkeletal fluorosis is an earlier manifestation of fluorosis seen as gastro-intestinal complaints etc and may overlap with other diseases leading to misdiagnosis.[24,25]

Prevalence: Fluoride prevalence was reported in 230 districts of 19 States earlier. As per recent data from Ministry of Drinking Water and Sanitation, there are 14,132 habitations (as on 1.4.2014) from 19 States which are yet to be provided with safe drinking water. The population at risk based on population in habitations with high fluoride in drinking water is 11.7 million.

Programme coverage: The National Programme for Prevention and Control of Fluorosis (NPPCF) was a new health initiative during 11th Five Year Plan, initiated in 2008-09 and is being expanded in a phased manner. 100 districts of 17 States were covered during 11th Plan, further 11 districts were taken up during 2013-15 (over 19 States) and additional 84 new districts are to be taken up during the remaining period of 12th Plan.[12,13]

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Goal and Objectives:- The NPPCF aims to prevent and control Fluorosis cases in the country. The Objectives of the National Programme for Prevention & Control of Fluorosis are as follows:

To collect, assess and use the baseline survey data of fluorosis of Ministry of Drinking Water and Sanitation for starting the project;
Comprehensive management of fluorosis in the selected areas;
Capacity building for prevention , diagnosis and management of fluorosis cases.[22,23]

Strategy: The following is the strategy for NPPCF:
Surveillance of fluorosis in the community;
Capacity building (Human Resource) in the form of training and manpower support;
Establishment of diagnostic facilities in the medical hospitals;
Management of fluorosis cases including treatment surgery, rehabilitation
Health education for prevention and control of fluorosis cases.

Activities:
Community Diagnosis of Fluorosis village/block/cluster wise.
Facility mapping from prevention, health promotion, diagnostic facilities, reconstructive surgery and medical rehabilitation point of view – village/block/district wise.
Gap analysis in facilities and organization of physical and financial support for bridging the gaps, as per strategies listed above.[14,15]

(a) Diagnosis of individual cases and providing its management.
(b) Public health intervention on the basis of community diagnosis.[21]
Behaviour change by IEC.
Training

Assistance provided to States
Strengthening manpower in endemic district by providing for :
- Consultant
-Laboratory Technician
-Field Investigators (3) for six months

- Purchase of equipment for lab including an Ion meter
- Training at various levels
- Health Education and Publicity

Treatment including reconstructive surgery and rehabilitation[16,17]

IV.CONCLUSIONS

Dental fluorosis is a major endemic oral disease characterized by hypomineralization of enamel caused due to consumption of water containing high concentration of fluoride during developmental stages of teeth.[1] Fluoride is considered an essential element required for prevention of dental caries. World Health Organization (WHO) has set the upper limit of fluoride concentration in drinking water at 1.5 mg/l[2] and the Bureau of Indian Standards, has therefore, laid down Indian standards as 1.0 mg/l as maximum permissible limit of fluoride with further remarks as "lesser the better." Intake of fluoride higher than the optimum level is associated with dental and skeletal fluorosis.[3],[4]Caries preventive effect of fluoride at concentration of 1 ppm has been well documented[5],[6] but at the same time ill effects of chronic fluoride toxicity in the form of dental fluorosis and skeletal fluorosis is also a matter of concern.Dental fluorosis is prevalent in many areas of Asia and Africa where the ground water contains higher concentration of fluoride. More than 23 countries in the world are endemic fluoride areas in which approximately 100 million people are suffering from dental fluorosis.[7]In India, 15 out of 32 states have been affected by the burden of dental fluorosis. It is more prevalent in the state of Bihar, Tamil Nadu, Andhra Pradesh, Gujarat, Rajasthan, Punjab and Haryana which is due to consumption of drinking water containing high concentration of fluorides.[8]Majority of the rural population in India are dependent on the ground water for drinking purposes hence they are at risk of developing dental fluorosis.In Haryana state, almost all districts except 6 (Panchkula, Yamunanagar, Ambala, Kurukshetra, Kaithal and Panipat) [19,20]have ground water with medium to high fluoride concentration.[9] Prevalence of dental fluorosis among children in ranged from 30% to 94.85% in the high-fluoride villages and from 8.80% to 28.20% in the low/normal-fluoride villages.[10]There is limited amount of information about the prevalence and severity of dental fluorosis in school children of endemic fluoride areas of Haryana. Hence the study was undertaken with the aim to

assess the prevalence of dental fluorosis among 11-14 years school children in endemic fluoride areas of Haryana and to find their treatment needs. In conclusion, our findings showed the increased prevalence of dental fluorosis in endemic fluoride areas with mild to moderate level of dental fluorosis. There was an urgent need to reduce the fluoride concentration of drinking water using appropriate defluoridation techniques and esthetic management of dental fluorosis.[18]

REFERENCES

1. Chaudhry M, Prabhakar I, Gupta B, Anand R, Sehrawat P, Thakar SS. Prevalence of dental fluorosis among adolescents in schools of Greater Noida, Uttar Pradesh. J Indian Assoc Public Health Dent 2016;15:36-41. [Full text]
2. Guideline for drinking water quality. World Health Organization (WHO) 2011.
3. Arlappa N, Aatif Qureshi I, Srinivas R. Fluorosis in India: An overview. Int J Res Dev Health 2013;1:97-102.
4. Zhang BO, Hong M, Zhao Y, Lin X, Zhang X, Dong J. Distribution and risk assessment of fluoride in drinking water in the west plain region of Jilin Province, China. Environ Geochem Health 2003;25:421-31.
5. Dean HT. Endemic fluorosis and its relation to dental caries. Public Health Rep 1938;53:1443-52.
6. Budipramana ES, Hapsoro A, Irmawati ES, Kuntari S. Dental fluorosis and caries prevalence in the fluorosis endemic area of Asembagus, Indonesia. Int J Paediatr Dent 2002;12:415-22.
7. Mollert IJ. Endemic dental fluorosis. In: Prabhu SR, Wilson DF, Daftary DK, Johnson NW, editors. Oral Diseases in the Tropics. Delhi: Oxford University Press; 1993. p. 68.
8. Susheela AK. Fluorosis: Indian Scienario: A Treatise on Fluorosis. New Delhi, India: Fluorosis Research and Rural Development Foundation; 2001.
9. Central ground water board north western region Chandigarh. Available from: http://cgwbchd.nic.in/qulhar.htm. [Last accessed 2016 Dec 6].
10. Yadav JP, Lata S, Sudhir K, Kumar S. Fluoride distribution in groundwater 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.
11. Thylstrup A, Fejerskov O. Clinical appearance of dental fluorosis in permanent teeth in relation to histological changes. Community Dent Oral Epidemiol 1978;6:315-28.
12. Mabelya L, van't Hof MA, König KG, van Palenstein Helderman WH. Comparison of two indices of dental fluorosis in low, moderate and high fluorosis Tanzanian populations. Community Dent Oral Epidemiol 1994;22:415-20.
13. Black GV, Mckay FS. Mottled teeth-An endemic developmental imperfection of the teeth heretofore unknown in the literature of dentistry. Dent COSMOS 1916;58:129-56.
14. Velazquez LNM, Fantinel LM, Ferreira EF, Castilho LS. Dental fluorosis endemism related to natural groundwater contamination by fluorine in Mid Sao Francisco basin, Minas Gerais State, Brazil. Fourth International Conference on Safe water, Rio de Janeiro. Safe Water 2006; p. 1-21.
15. Yadav KA, Khan P. Fluoride and fluorosis status in groundwater of Todarai Singh area of district Tonk (Rajasthan, India). Int J Chem Environ Pharm Res 2010;1:6-11.
16. Bhagavatula P, Levy SM, Broffitt B, Weber-Gasparoni K, Warren JJ. Timing of fluoride intake and dental fluorosis on late-erupting permanent teeth. Community Dent Oral Epidemiol 2016;44:32-45.
17. Bharati P, Kubakabaddi A, Rao M. Clinical symptoms of dental and skeletal fluorosis in Gadag and Bagalkot districts of Karnataka. J Hum Ecol 2005;18:105-7.

18. Mamatha P, Rao MS. Geochemistry of fluoride rich in groundwater in Kolar and Tumkur districts of Karnataka. Environ Earth Sci 2010;61:131-42.

19. Dean HT. The investigation of physiological effects by the epidemiological method. In: Moulton FR, editor. Fluorine and Dental Health. Washington DC: American Association for the Advancement of Science; 1942. p. 23-32.

20. Anguilar-Díaz FC, Irigoyen-Camacho ME, Borges-Yáñez SA. Oral-health-related quality of life in schoolchildren in an endemic fluorosis area of Mexico. Qual Life Res 2011;20:1699-706.

21. Onoriobe U, Rozier R, Cantrell J, King R. Effects of enamel fluorosis and dental caries on quality of life. J Dent Res 2014;93:972-9.

22. Tellez M, Santamaria RM, Gomez J, Martignon S. Dental fluorosis, dental caries and quality of life factors among schoolchildren in a Colombian fluorotic area. Community Dent Health 2012;29:95-9.

23. Do LG, Spencer A. Oral health-related quality of life of children by dental caries and fluorosis experience. J Public Health Dent 2007;67:132-9.

24. Vuhahula EAM, Masalu JRP, Mabelya L, Wandwi WBC. Dental fluorosis in Tanzania great rift valley in relation to fluoride levels in water and in 'Magadi' (Trona). Desalination 2009;248:610-5.

25. Mann J, Tibi M, Sgan-Cohen HD. Fluorosis and caries prevalence in a community drinking above-optimal fluoridated water. Community Dent Oral Epidemiol 1987;15:293-5.

26. Bhalla A, Malik S, Sharma S. Prevalence of dental fluorosis among school children residing in Kanpur City, Uttar Pradesh, India. Eur J Gen Dent 2015;4:59-63. [Full text]

27. Singh A, Laura JS, Rana A. Fluoride distribution in groundwater and prevalence of dental fluorosis among school children in villages of Jind district, Haryana (India). Int J Current Res 2013;5:998-1002.

28. Dahiya S, Kaur A, Jain N. Prevalence of fluorosis among school children in rural area, district Bhiwani: A case study. Indian J Environ Hlth 2000;42:192-5.

29. Khan SQ, Moheet IA, Farooq I, Farooqi FA, ArRejaie AS, Al Abbad MA, et al. Prevalence of dental fluorosis in school going children of Dammam, Saudi Arabia. J Dent Allied Sci 2015;4:69-72. [Full text]

30. Kotecha PV, Patel SV, Bhalani KD, Shah D, Shah VS, Mehta KG. Prevalence of dental fluorosis and dental caries in association with high levels of drinking water fluoride content in a district of Gujarat, India. Indian J Med Res 2012;135:873-7. [PUBMED] [Full text]

31. Gupta A, Dhingra R, Chaudhuri P, Gupta A. A comparison of various minimally invasive techniques for the removal of dental fluorosis stains in children. J Indian Soc Pedod Prev Dent 2016;35:260-8. [PUBMED] [Full text]

32. Penumatsa NV, Sharanesha RB. Bleaching of fluorosis stains using sodium hypochlorite. J Pharm Bioallied Sci 2015;7(Suppl 2):S766-8.