Original Article

Health Impact to Different Concentrations of Fluoride in Drinking Water of South India

M. Shanthi[1], B V Thimma Reddy[2], Shivani Kohli[3]

[1]MDS & Senior Lecturer, Department of Pediatric Dentistry, MAHSA University, Kuala Lumpur, Malaysia, [2] MDS, Professor & Head, Department of Pediatric and Preventive Dentistry, Mamata Dental College & Hospital, Khammam, India, [3] MDS & Senior Lecturer, Department of Prosthodontics, MAHSA University, Kuala Lumpur, Malaysia

Corresponding Author: *Dr M. Shanthi M.D.S, Senior Lecturer, Pediatric Dentistry, Mahsa University, Malaysia. E-mail: shanthineha2012@gmail.com*

Abstract

Background: India lies within the geographical fluoride belt that extends from Turkey to China. Nearly 12 million of the 85 million tons of fluoride deposits on earth's crust is found in India. Excessive fluoride in drinking water causes dental fluorosis, skeletal fluorosis and general health problems. About 20 states of India are identified as endemic for fluorosis. The highest rate of endemicity has been reported from Andhra Pradesh, Haryana, Karnataka, Punjab, and Tamilnadu. Till today no data is available on the health impact of fluoride (F) in Nelakondapally Mandal of Khammam district, Andhra Pradesh (A.P). Hence this area was considered as an ideal location for conducting this survey.

Objective: To determine fluoride level in ground water and correlate its impact on public health.

Methods: Water samples from 38 villages of Nelakondapally Mandal were subjected to fluoride analysis using Orion 720A ion-specific electrometer, to confirm the fluoride levels in the drinking water before commencement of clinical examinations**.** 240 individuals aged 6-54 years from Nelakondapally Mandal of Khammam district (A.P) were examined for manifestations of dental, skeletal and non-skeletal manifestations of fluorosis.

Results: There was significant positive correlation between water fluoride levels to various form of fluorosis. Among the study population, prevalence of dental fluorosis was 47.9%, skeletal fluorosis 13.7% and non skeletal manifestations 3.7% respectively.

Conclusion: The survey revealed higher incidence and severity of dental, skeletal and non-skeletal fluorosis among the study population. Skeletal manifestations were high in males and with increasing age, the severity became more evident restricting physical movements.

Keywords: Dental fluorosis, Fluoride (F), Nelakondapally Mandal, Skeletal fluorosis

INTRODUCTION

Water is our body's principle chemical component and makes up about 60 percent of body weight. It is essential to good health and lot of functions like regulating body temperature, carrying nutrients to cells, flushes toxins out of vital organs and so on. It is life for all living beings. But nowadays, pure drinking water is available to very few people and others take more or less contaminated water. The contamination may be caused either by natural forces or by industrial effluents, and one such contamination is fluoride (F).[1,2]

F is the most highly reactive element of the halogen family. It exists in water mainly as F ion.[3] F has dual significance, if F content in water is less it may cause caries, and if it is in excess it may causes fluorosis. The requirement of F content changes and it mainly depends on the geographical condition and age of the human beings. Among the F concentration in ground water, resources have become one of the most important toxicological and geo-environmental issues in India. Fluorosis is a major public health problem in 20 states in India. Human intake of is chiefly determined by F content in water, food as well as air. The population areas with high F content in drinking water are exposed to the risk of endemic fluorosis.[4]

Fluorosis disease can occur in three forms: Dental fluorosis, skeletal fluorosis, and non-skeletal fluorosis. Dental fluorosis results in hypo-mineralization of tooth enamel due to the continuous ingestion of excessive amount of F during tooth development. This results in a

variety of pathological changes in the structure of teeth and if not prevented during childhood can hamper dental esthetics and psychological well-being.[5] It is regarded as an unfortunate side effect to its caries protective benefits. Skeletal fluorosis[6] affects the bones and major joints of the body. The bone gets hardened and less elastic, resulting in an increased frequency of fractures. Non-skeletal fluorosis affects invariably all the soft tissues, organs and systems of the body. Excessive F results disturbances in soft tissues due to chronic intoxication. Till today no data is available on the health impact to the different water F levels at this Mandal and this makes Nelakondapally Mandal an ideal place for the present descriptive epidemiological study, and the correlation between these interrelated afflictions.

MATERIALS AND METHODS

According to the survey conducted by Rajiv Gandhi National Drinking Water Mission[7] fluorosis was prevalent in all districts of A.P including Nelakondapally Mandal of Khammam District.

Nelakondapally Mandal experiences hot and dry summer throughout the year, expect during the south west monsoon season that extends from June to September. The mean annual temperature is about 45°C. The main staple food in this region is rice. General living conditions and socio-economic status were comparatively similar in all villages. 70% population is involved in agriculture. This Mandal had drinking water supply from tanks and wells. Water from primary sources such as wells is pumped into storage tank and the supply remains constant.

Collection and Analysis of Water Samples

Collection of water samples was done based on the methodology followed in National Oral Health survey and F Mapping 2002-2003.[8] The water samples were sent to the laboratory of 'Rural Water Supply, Nalgonda to confirm the F levels in the water before commencement of clinical examination. Water F analysis was done using Orion 720A fluoride meter, coupled with ion specific electrode. The entire geographical area of Nelakondapally Mandal was divided into 3 strata, based on the concentrations of naturally occurring F in drinking water (Table 1). After taking informed consent and explaining the purpose of the study selected population were interviewed with a pre-designed questionnaire and clinically examined for identification of signs and symptoms of suspected dental, skeletal and non-skeletal fluorosis along with their food habits, addictions and use of fluoride containing tooth paste.

Clinical Examination

Type-III clinical examination,[9] as recommended by American Dental Association (ADA) was followed throughout the study for intra oral examinations. Emphasis was laid on importance of routine, simple preventive measures and periodic dental visits. Dental fluorosis, skeletal fluorosis and non-skeletal fluorosis were assessed by diagnostic criteria developed by fluorosis research and rural development foundation, New Delhi.[8]

Inclusion Criteria

Study population who satisfied the following criteria were included in the study.[10]

1) Individuals aged between 6-54 years irrespective of sex, race, and socio-economic status who were residents of that particular region and who were using the same source of drinking water.
2) Individuals who were willing and cooperative for the study.

Exclusion Criteria

1) Individuals who had migrated from some other place or who were not the permanent residents of that particular area.
2) Severe extrinsic stains on their teeth in which assessing fluorosis is not possible.
3) Individuals suffering with any communicable or systemic diseases and fractured anterior teeth.

The single examiner concept was followed as it maintains consistency and eliminates inter examiner bias. To ensure continuous consistency in recordings, 10% of study population was randomly re-recorded, compared each day and constant check was maintained throughout the study. Data collected was analyzed.

RESULTS

Out of 240 study population aged between 6-54yrs, 156 (65%) were males and 84 (35%) were females. Out of total study population 157 (65.4%) were affected by either dental, skeletal fluorosis or non-skeletal manifestations. All the individuals who were affected with fluorosis have resided in the respective villages since birth. The disease incidence was more in males (42.5%) than in females (22.9%) (Table 2). Dental fluorosis afflicted 66% of males and 33.9% of females. Table 3 shows prevalence of different grades dental fluorosis. 46% with grade 2, 25.2% grade 1, 18.2% grade 3, 7.8% grade 4, 2.6% grade 5

Table 1: Three strata with different F levels in drinking water

Strata	F content in ppm
Strata 1	<0.7 ppm
Strata 2	0.7-1.2 ppm
Strata 3	>1.2 ppm

fluorosis. The earliest evidence of dental fluorosis was observed among children around 6-10 yrs of age and of skeletal fluorosis around 11-20 years of life. Distribution of degree of skeletal fluorosis was high in males (63.6%) compared to females (36.4%). Among the different clinical signs and symptoms of skeletal fluorosis, 8.7% had joint pains, 15.1% had difficulty in walking, 12.1% had knock-knees, 0.8% had back pain and stiffness, and 3% had loss of sense and perception (Table 4). As the age advances, the manifestations of skeletal fluorosis became more evident, restricting physical movements and causing difficulty in walking. The incidence of mild form of skeletal fluorosis like joint pains, back pains was more prevalent in males, whereas knock-knees are equally prevalent among males and females. Disease manifestations of non-skeletal fluorosis was slightly higher in males (55.6%) compared to females (44.4%). 3.3 % had pain in stomach and loss of appetite, 3.7 % had muscle weakness, 2.9 % had fatigue and depression, 2.5% has polyurea and polydispia (Table 5).

DISCUSSION

From the present study, the overall prevalence of dental fluorosis was found to be 47.9 %. Many studies in the past have proved the direct link between the degree of dental fluorosis and the amount of F in drinking water in the respective communities and countries. Baskarados[11] reported in Tamilnadu overall prevalence of dental fluorosis to be 15.8%, Choubisa[12] (45.7%), Bharthi *et al*[13] (35%), Acharya[14] (16-100%), Nanda[15] (0.15%) in India, Kumar[16] (7-10% in fluoridated areas and 5-9% in non fluoridated areas) in Newburgh, Shourie[17] (36.5%) in India, Vacher[18] (51.57%) in Amritsar, Thaper[19] (59.10%) in Moga, Ramchandran[20] (66.2%) in Tamilnadu, Tewari and Chawla[21] (81.60%) in urban areas of India, Subba Reddy VV[22] (24-31%) in Punjab.

Prevalence of manifestations for skeletal fluorosis was found to be 13.7%. Earlier studies like Majumdar[23] (23.8-34.1%), Bharthi *et al* (17%), Choubisa (22%), showed various degree of skeletal fluorosis The incidence of mild and severe form of skeletal fluorosis was almost equally predominating in males and females. Earlier studies have indicated that the incidence and severity of chronic fluoride intoxication was greatly influenced by socio-economic, climatic and nutritional status, being higher in poorer segments of the population with signs of nutritional deficiency. Prevalence of non skeletal manifestations among the present study population was about 3.7%.

Table 2: Gender distribution of fluorosis

Group	Total number surveyed	Affected with fluorosis (%)	Dental fluorosis	Skeletal fluorosis	Non skeletal fluorosis
Males	156	102 (63.3)	76 (48.7)	21 (13.5)	5 (3.2)
Females	84	55 (65.4)	39 (46.4)	12 (4.2)	4 (4.7)
Total	240	157 (65.4)	115 (47.9)	33 (13.7)	9 (3.7)

Table 3: Distribution of degree of dental fluorosis

Group	Affected with dental fluorosis	Grade 1 (%)	Grade 2 (%)	Grade 3 (%)	Grade 4(%)	Grade 5 (%)
Males	76	21 (27.6)	36 (47.3)	11 (14.4)	6 (7.8)	2 (2.6)
Females	39	8 (20.5)	17 (43.5)	10 (25.6)	3 (7.6)	1 (2.5)
Total	115	29 (25.2)	53 (46)	21 (18.2)	9 (7.8)	3 (2.6)

Table 4: Distribution of degree of skeletal fluorosis

Group	Total number surveyed	Joint pains	Back pain & stiffness of back	Difficulty in walking	Knock-knees	Loss of sensation perception
Males	21	13 (5.4)	2 (0.8)	3 (1.2)	2 (0.8)	1 (0.4)
Females	12	8 (3.3)	0 (0)	2 (0.8)	2 (0.8)	0 (0)
Total	33 (13.7)	21 (8.7)	2 (0.8)	5 (15.1)	4 (12.1)	1 (3)

Table 5: Distribution of non skeletal fluorosis

Group	Total number surveyed (%)	Pain in stomach	Loss of appetite	Muscle weakness	Polyurea\polydispia	Fatigue depression
Males	5	5 (100)	5 (100)	5 (100)	4 (80)	3 (60)
Females	4	3 (75)	3 (75)	4 (100)	2 (50)	4 (100)
Total	9 (3.7)	8 (3.3)	8 (3.3)	9 (3.7)	6 (2.5)	7 (2.9)

CONCLUSION

It is said that there is an urgent need for basic health care in the study area. Community and domestic water de-fluoridation measures need to be monitored on urgent basis. Awareness regarding the sources and ill effects of fluoride has to be spreaded in the population through health education. These measures could avoid possibly fluorosis as much as possible in these rural areas.

REFERENCES

1. Asha G, Yadav AK, Sharma HR. Fluoride facts. *Indian Journal of Environmental Protection*. 2002; 22(3):3.
2. Chengappa NK. Fluorides in water. Madras University 1970.
3. Aoba T, Fejerskov O. Dental fluorosis: Chemistry and biology. *Crit Rev Oral Med.* 2002;13(2):155-70.
4. Shan N. Oral and dental diseases-causes, prevention and treatment strategy. *NCMH back ground papers, burden of disease in India September 2005.*
5. Rodd HD, Davidson LE. The aesthetic management of severe dental fluorosis in the young patient. *Dental Update*. 1997; 24:408-11.
6. Desai VK, Solanki DM, Kantharia SL, Bhavsar BS. Monitoring of neighborhood fluorosis through a dental fluorosis survey in schools. *Fluoride*. 1993; 26(3):181-86.
7. Fluoride and fluorosis: National Prevalence, 2007.
8. National oral health survey and fluoride mapping 2002-2003, India DCI, New Delhi 2000.
9. Peter S. Essentials of preventive and community dentistry. 3rd edition Arya (Medi) Publishers, New Delhi 2003.
10. Sudhir KM, Prashant GM, Subba Reddy VV, Mohandas U, Chandu GN. Prevalence and severity of dental fluorosis among 13-15 year old school children of an area known for endemic fluorosis: Nalgonda district of Andhra Pradesh. *J Indian Soc Pedod Prevent Dent*. 2009; 27(4):190-6.
11. Baskaradoss JK, Clement RB, Narayanan A. Prevalence of dental fluorosis and associated risk factors in 11-15 year old school children of Kanyakumari district, Tamilnadu, India: A cross sectional survey. *Indian J Dent Res*. 2008; 19(4):297-303.
12. Choubisa SL. Endemic fluorosis in southern Rajasthan, India. *Fluoride*. 2001; 34:61-70.
13. Bharati P, Kubakaddi A, Rao M, Naik RK. Clinical symptoms of dental and skeletal fluorosis in Gadag and Bagalkot districts of Karnataka. *J Hum Ecol*. 2005; 18:105-7.
14. Acharya S. Dental caries its surface susceptibility and dental fluorosis in South India. *International Dental Journal.* 2005; 55:359-364.
15. Nanda RS, Zipkin I, Dovle J, Horowitz HS. Factors affecting the prevalence of fluorosis in luknow, India. *Arch Oral Biol Sep.* 1974; 19(9):781-92.
16. Kumar J, Swango P, Haley V, Green E. Intra-oral distribution of dental fluorosis in Newburgh and Kingston, New York. *J Dent Res*. 2000; 79:1508-13.
17. Shourie KL. Prevalence of dental caries to different levels of fluoride in drinking water from Lahore district. *J Indian Dent Assoc*. 1953; 26(2) 701.
18. Vacher BR. Dental survey of school children in Amritsar. *J All Indian Dent Assoc.* 1952; 24(1) 1-2.
19. Thapar SL. Incidence of dental caries in Punjabi children. *J All Indian Dent Assoc.* 1973; 45(4) 27-30.
20. Ramachandran K, Rajan BP, Shanmugham S. Epidemiological studies of dental disorders in Tamilnadu population: Prevalence of dental caries and periodontal disease. *J Indian Dent Assoc.* 1973;45(4) 65-70.
21. Tewari A, Chawla HS. Study of prevalence of dental caries in an urban area of India, Chandigarh. *J Indian Dent Ass.* 1977;49:231-239.
22. Reddy S, Tewari A. Prevalence of dental caries to different levels of fluoride in drinking water. *J Indian Dent Assoc*.1992;63(11):455-461.
23. Majumdar KK. Health impact of supplying safe drinking water containing fluoride below permissible level on fluorosis patients in a fluoride-endemic rural area of West Bengal. *Indian Jour of Public Health*. 2011; 55(4):303-308.

How to cite this article: M. Shanthi, B V Thimma Reddy, Shivani Kohli. "Health Impact to Different Concentrations of Fluoride in Drinking Water of South India". Int J Sci Stud. 2014;2(3):2-5.

Source of Support: Nil, **Conflict of Interest:** None declared.