

AN EPIDEMIOLOGICAL STUDY OF SKELETAL FLUOROSIS IN SOME VILLAGES OF CHANDRAPUR DISTRICT, MAHARASHTRA, INDIA

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ABSTRACT

Fluorosis is an important public health problem in certain parts of India. Chandrapur is one of the fluorosis endemic district of Maharashtra. An investigation was undertaken in three villages of study area to assess the clinical symptoms of skeletal fluorosis and in turn to find out the severity of the disease. A door to door approach with face to face interviews of the study population was carried out and classified into three age groups i.e. 30-45 yrs (529), 46-60 yrs (387) and 61 yrs to above (262) for different grades of clinical symptoms and collected information was entered in a precoded questionnaire. Fluorosis was diagnosed clinically and as well as the drinking water samples were tested for fluoride level. The concentration of fluoride in drinking water varies from 0.66 to 5 mg/l. Among the 1178 subjects (572 males and 606 females) surveyed 367 (31.15%) patients exhibited the symptoms of different grades of skeletal fluorosis. The skeletal symptoms including tingling and numbing of extremities, joint pain in both upper and lower limbs, unable to bend, unable to bend neck, back pain, shoulder pain and knock-knee. Prevalence of skeletal fluorosis was found to be 20.22% (30-45 yrs), 34.62% (46-60 yrs) and 48.09% (61 yrs to above). A direct association existed between age and severity of skeletal fluorosis. A higher prevalence was recorded in the older one (61 yrs to above). With advancing age, the prevalence of skeletal fluorosis increased and it was more prevalent among males (36.18%) than the females (26.40%).

Key Words : Fluoride, Drinking water, Skeletal fluorosis, Warora tehsil, Maharashtra

INTRODUCTION

Endemic fluorosis has been observed in many parts of the world where drinking water contains excessive amount of fluoride. Fluoride is beneficial to health at low concentration, a higher concentration causes serious health hazards. The disease caused manifests itself in three forms, namely, dental, skeletal and non-skeletal fluorosis. The World Health Organization guideline recommendation for maximum limit of fluoride in drinking water is 1.5 mg/l.¹ The epidemiological evidence that concentration above this value carry an increasing risk of dental fluorosis and progressively higher concentration lead to increasing risks of skeletal fluorosis forms the basis of guideline derivation. Although fluorosis is most severe and widespread in India and China, it is endemic in at least 25 countries

across the globe.² In Maharashtra 30% -50 % of the districts are affected. Chandrapur district have shown the fluoride concentration in 27 villages in the range of 1.0 – 4.6mg/l respectively which is much above the permissible limits of fluoride in drinking water. The district, as being one of the endemic district for ground water fluoride concentration.³ In some villages, adult population suffers from both dental and skeletal fluorosis while, children have dental fluorosis. The suffering and disability of the people in all age groups in fluorosis endemic village in Chandrapur district, Maharashtra, India becoming so alarming and the pain of fluorosed subjects increasing.

AIMS AND OBJECTIVES

In the light of the above findings, the present study was carried out to evaluate the toxic effects of excess fluoride on human health in the three

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villages of Warora tehsil, Chandrapur district, Maharashtra, India.

METHODOLOGY

Study area

Warora tehsil, Chandrapur district, Maharashtra, India. The present study was carried out during May 2010 to December 2011 in three villages which were randomly selected from Warora tehsil of Chandrapur district, India which is one of the endemic district of Maharashtra, India. The area selected for present study lies in western part of Chandrapur district and located at 20 14'N 79 00'E/ 120.28 N 79.00 E. The climate of the area is extreme type. The summer is very hot and winter is very cool and pleasant. The average annual rainfall is about 1420 mm.

Collection of water samples and analysis

15 water samples were collected from all the available ground water sources to assess the fluoride ion concentration. Fluoride ion concentrations were measured with an ion analyzer. The main sources of drinking water in these villages are dug wells and bore wells.

Selection of sample

The villages comprise 3771 individuals in various age groups which were selected. A door to door approach with face to face interviews was carried out. All the households in three villages were enumerated and a list was made. There were 980 households and this formed the sampling frame. For skeletal fluorosis adults over the age of 30 years and who had lived in one of the three villages for at least 15 years were included in the study. As a result 1178 persons were selected. All the individuals i.e.1178 after applying the inclusion / exclusion criteria yielded a study population of 367 persons. Individuals who could perform three diagnostic tests (physical signs) for clinical assessment of skeletal fluorosis were included in the study. Before start the study the ethical permission was taken from the department of ethical committee. After explaining the purpose of the visits and camps, data was collected by one of the four authors of the study. Informed consent was taken from the study subjects or from the parents in case of children. A questionnaire was designed to collect information regarding names, sex, age,

occupation, dietary habits, drinking water sources, duration of stay and clinical symptoms of skeletal fluorosis.

Skeletal fluorosis was diagnosed by three diagnostic tests : 1-touching the toes without bending the knees, 2- touching the chest with the chin and 3- stretching the arms sideways and folding the arms to touch the back of the head⁴. If there is pain or stiffness in the backbone, hip and joints or pain or stiffness in the neck, shoulder joint and backbone, respectively these three exercises cannot be performed.

RESULTS AND DISCUSSION

In the three villages of our study area the range of fluoride concentration of the presently available ground water sources was estimated to be 0.66 – 5 mg/l (**Table 1**). Out of 1178 study subjects, 572 (48.55%) males and 606 (51.44%) were females and majority 529 (44.90 %) of the study population were in the age group of 30 – 45 years (**Table 2**). Majority of the males 118 (20.62%) and the females 122 (20.13%) belong to the age group of 30 - 45 years. Clinical symptoms of skeletal fluorosis patients from study area like tingling and numbing of extremities, joint pain, back pain and knee pain were high among population (**Table 3**). It was observed that 367 persons out of 1178 (100%) study subjects were found to be suffering from skeletal fluorosis with a prevalence of 31.15%. The prevalence of skeletal fluorosis increased with age and this association was found to be statistically significant, it was seen that out of the total fluorosis 367(100%) cases most 126 (48.09%) of the skeletal fluorosis cases were seen in the age group of 61 years to above (**Table 4**). Male fluorosis cases 207 (36.18%) were more than female fluorosis cases 160 (26.40%), higher percentage of males suffered from pain and stiffness of limbs along with joint pain compared to their female counterparts. Prevalence of skeletal fluorosis was more prevalent among males than the females and this association was also found to be statistically significant. Males outnumbered the females in distribution of skeletal fluorosis cases (**Table 5**). The present results revealed that the fluoride concentration in the drinking water of the study area was found in the range of 0.66 – 5mg/l. Shashi et al.⁵ shown that in three

endemic villages of Punjab the fluoride concentration ranges from 3-22.5 mg/l. Narwaria and Saksena⁶ observed that in all ten villages of Karera block in Madhya Pradesh the fluoride concentration was found 1.65 mg/l in Hazinagar and 3.91 mg/l in Dumduma

village. Mishra et al.⁷ and Ratna Roy⁸ shown that the concentration of fluoride ranges from 1.98 to 4.85 mg/l and 1.98 to 8.82 mg/l in postmonsoon as well as 2.02 to 5.42 mg/l and 2.31 to 9.25 mg/l in premonsoon months in their study.

Table 1 : Fluoride content of drinking water in different villages of study area

S/N	Name of villages	Total population	Total number of households	Sources of drinking water	Fluoride range (mg/l)	Staple food
1	Dongergaon	1574	258	BW and DW	0.66 – 5	Wheat and Rice
2	Chikani	1964	482	BW and DW	0.93 – 1.26	Wheat and Rice
3	Pimpalgaon	293	240	BW and DW	0.66 – 0.86	Wheat and Rice

BW – Bore well, DW – Dug well

Table 2 : Distribution of examinees by age and sex

S/N	Age distribution	Villages			Total
		Dongargaon	Pimpalgaon	Chikani	
1	30-45yrs	240 (45.36%)	93(17.58%)	196(37.05%)	529(100%)
2	46-60yrs	207(53.48 %)	57(14.72%)	123(31.78%)	387(100%)
3	61yrs to above	137(52.29%)	50(19.08%)	75 (28.62%)	262(100%)
	Sex distribution	Dongargaon	Pimpalgaon	Chikani	Total
1	Male	285(48.80%)	102(51%)	185(46.95%)	572(48.55%)
2	Female	299 (51.19%)	98(49%)	209(53.04%)	606(51.44%)
	Total	584 (100%)	200(100%)	394 (100%)	1178(100%)

Figures in parenthesis indicate percentages

Table 3 : Clinical symptoms of skeletal fluorosis among fluorotic subjects from study area

S/N	Symptoms	Number of patients / cases		
		Male	Female	Total
1	Tingling and numbing of extremities	14 (6.76%)	9 (5.62%)	23 (6.26%)
2	Joint pain	54 (26.08%)	46 (28.75%)	100 (27.24%)
3	Back pain	35 (16.90%)	37 (23.12%)	72 (19.61%)
4	Knee pain	21 (10.14%)	11 (6.87%)	32 (8.71%)
5	Shoulder pain	7 (3.38%)	4 (2.50%)	11 (2.99%)
6	Neck pain	11 (5.31%)	8 (5.00%)	19 (5.17%)
7	Pain in limbs	11 (5.31%)	9 (5.62%)	20 (5.44%)
8	Stiff limbs	9 (4.34%)	7 (4.37%)	20 (5.44%)
9	Stiff vertebral column	13 (6.28%)	5 (3.12%)	18 (4.90%)
10	Bent/kyphosis	2 (0.96%)	1 (0.62%)	3 (0.81%)
11	Unable to walk properly	8 (3.86%)	3 (1.87%)	11 (2.99%)

12	Bowed legs	--	--	--
13	Can't do normal work	7 (3.38%)	6 (3.75%)	13 (3.54%)
14	Difficult to sit in squatting position	--	2 (1.25%)	2 (0.54%)
15	Can't cross legs	2(0.96%)	5 (3.12%)	7 (1.90%)
16	Can't fold hands	8 (3.86%)	3 (1.87%)	11 (2.99%)
17	Can't get up when sits	5 (2.41%)	4 (2.50%)	9 (2.45%)
	Total	207 (100%)	160 (100%)	367 (100%)

Figures in parenthesis indicate percentages

Table 4 : Prevalence of skeletal fluorosis according to age

S/N	Age groups (Years)	Skeletal fluorosis	No symptoms	Total
1	30 - 45	107 (20.22%)	422 (79.77%)	529 (100%)
2	46 - 60	134 (34.62%)	253 (65.37%)	387 (100%)
3	61- Above	126 (48.09%)	136 (51.90%)	262 (100%)
	Total	367 (31.15%)	811 (68.84%)	1178 (100%)

Figures in parenthesis indicate percentages

$X^2 = 66.66$; $df = 2$; $p < 0.0001$

Table 5 : Prevalence of fluorosis among males and female

S/N	Sex	Prevalence of skeletal fluorosis	No symptoms	Total
1	Male	207 (36.18%)	365(63.82%)	572 (100%)
2	Female	160 (26.40%)	446 (73.59%)	606 (100%)
	Total	367 (31.15%)	811 (68.84%)	1178 (100%)

Figures in parenthesis indicate percentages $X^2 = 13.13$; $df = 1$; $p < 0.01$

In the present study on skeletal fluorosis in endemic villages of Warora tehsil of Chandrapur district, Maharashtra, India it was observed that females (51.44%) formed majority of the study population. Nirgude et al.⁹ reported a similar finding in Nalgonda district of Andhra Pradesh. As well as the present result on gender wise, the majority of males (20.62%) and female (20.13%) belong to the age group of 30 – 45 years. Nirgude et al.⁹ reported in their findings female (25 – 39 years) and male (40 -60 years) and Ravi Kiran and Vijaya K² shown that female (42.8%) and male (37.9%) belong to the age group of 21 – 40 years. They also shown in their results majority of the skeletal fluorosis cases were in the age group of 40 – 60 years. Our study shown that the majority (48.09%) of fluorosis cases in the age group of 61 years to above. In the present clinical examination it was seen that the most common symptoms joint pain (27.24%), back pain (19.61%) and other symptoms like tingling and numbing of

extremities, shoulder pain, neck pain and stiffness are the symptoms of skeletal fluorosis. Gupta et al.¹⁰ in their study found that the common symptoms are pain in the neck and back associated with rigidity, joint pains and paraesthesia of the limb. The physical findings include postural defects like kyphosis, limitation of the movements of the spine and exostosis. Ravi Kiran and Vijaya K² in their study observed that back pain (68%) and joint pain (22%). Shashi et al.⁵ shown that back pain (73%) and neck pain (34%) in their study. Nirgude et al.⁹ in their study observed that pain or stiffness in the backbone and hip (16.2%) and pain or stiffness in joints and backbone (15.5%).

In the present finding the overall prevalence of skeletal fluorosis cases was found to be (31.15%). Nirgude et al.⁹ (24.9%) and Ravi Kiran and Vijaya K² (21%) shown in their results of prevalence of skeletal fluorosis. As well as the skeletal fluorosis prevalence increased with age and this association was

found to be statistically significant by Chi-square test ($P < 0.0001$) this type of finding also seen in Andhra Pradesh by Nirgude et al.⁹ The skeletal fluorosis was more prevalent among males (36.18%) than females (26.40%) and this association was also found to be statistically significant by Chi-square test ($P < 0.01$). The results are in agreement with those reported by Gupta et al.¹⁰ Shashi et al.⁶ and Nirgude et al.⁹ in their study found that skeletal fluorosis was to be more common among males (34.1%).

CONCLUSION

The present study revealed that the occurrence of fluorosis in the villages of Warora tehsil, Chandrapur district of Maharashtra, India. Further studies are required in fluoride endemic villages to reveal the magnitude of the problem caused by fluoride. The prevalence of skeletal fluorosis increased with age and it is also sex dependent. However, the drinking water is the responsible factor for the prevalence of skeletal fluorosis. There is a need of defluoridate water supply and vitamin C and Calcium rich diet to ameliorate the severity of the diseases.

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