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Water borne disease - Fluorosis, A Silent Killer
A Case Study of Dausa District, Rajasthan

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Abstract

The disease fluorosis is caused by Fluoride in either drinking water or edible substances. Fluorine is an element of Halogen group with molecular weight 19 and atomic number 9. Fluorine is the most electro negative of all elements. Fluorine exists as a diatomic molecule with remarkably low dissociation energy. As a result, it is highly reactive and has strong affinity to combine with other elements to produce compounds known as fluoride.

Fluoride in drinking water of Rajasthan have been found to originate from rocks. All the 32 districts of Rajasthan have been identified as fluorosis prone area. This paper pertains to a study carried out in Dausa district. Water samples were collected from different sources periodically and analysed. Upto 14.9 ppm of fluoride has been found in the study area as against 1.5 ppm of fluoride, a W.H.O. approved permissible limit. Observations were made related to Dental and Skeletal fluorosis in the study area. Medical practitioners and diseased (fluoride affected) persons were interviewed.

Introduction

Fluorosis has been known in India for the last six decades. The disease can be observed in different stages from progressive stage to the serious and chronic maladies. It affects children, young people and human beings in old age. Water borne fluorosis is known to cause hydro fluorosis, whereas food borne fluorosis is known to cause food borne fluorosis and it is difficult to differentiate between water borne and food borne fluorosis. Consumption of fluoride rich water or food for a period of one year is sufficient to cause fluorosis. Fluorosis in India is endemic to some states. Effects of fluoride are more severe and widely spreaded in Uttar Pradesh, Rajasthan, Gujarat, Andhra Pradesh and Tamil Nadu. Fluoride enters the body through a variety of sources like water, food, milk etc. Excessive ingestion of fluoride cause skeletal fluorosis. In Human beings skeletal fluorosis is characterized by (a) severe pain and stiffness in the neck and back bone (b) severe pain and stiffness in joints and (c) severe pain and stiffness in hip joints.

The present study was carried out by selecting Dausa district as the study area. Dausa district has 350 villages. People are reported to be affected by fluorosis in 98 villages, in Dausa district. In the present study an investigation has been made pertaining to the adverse impact of high fluoride content in water on vegetation from the agricultural fields and on human health.

Table 1 **Analysis of Fluorides contents in vegetables/crops from different villages of Dausa District**

		Sample analyzed in (mg/1)		
Name of Village	**Year**	**Wheat**	**Potato**	**Tomato**
Bairwa Mohalla/Hingotia/Dausa	1998	3.24	1.22	1.10
Bariwas/Dausa		14.2	2.89	4.09
Jirotakala/Dausa	1999	3.48	1.26	1.10
Malarana/Dausa		9.11	2.15	2.9
Jhonpuria/Dausa		10.72	2.92	4.6
Jag Sahaipura/Dausa	2000	3.56	1.27	1.5
Khanwas/Dausa		14.3	2.92	4.19

Table 2 **Analysis of Fluoride contents in water collected from different villages of Dausa District**

Name of the village	**Sources of water**	**1999**			**2000**			**2001**		
		June	**Sept**	**Dec**	**March**	**June**	**Sept**	**Dec**	**March**	**June**
Bairwa Mohalla/ hingotia/Dausa	Hand pump & Open well	14.8	14.6	14.6	14.7	14.9	14.6	14.6	14.7	14.8
Seengpura/chianpura/ Dausa	Open well	9.6	9.4	9.4	8.6	9.9	9.4	9.4	8.6	9.8
Bairwas/Dausa	Hand Pump	5.6	5.2	5.2	6.4	5.7	5.2	5.2	6.4	5.7
Jirotakala/Dausa	Hand Pump	5.6	5.3	5.3	5.7	5.8	5.3	5.3	8.2	5.6
Malarana/Dausa	Hand Pump	8.8	8.1	8.0	8.3	8.8	8.1	8.0	5.8	8.8
Jhonpuria/Dausa	Hand Pump	5.8	5.2	5.1	5.8	5.7	5.2	5.1	5.6	5.6
Jag Sahaipura/Dausa	Hand Pump	5.6	5.1	5.1	5.6	7.1	5.1	5.1	5.6	7.0
Khandewal/Dausa	Open well	6.8	6.4	6.4	6.2	6.7	6.4	6.4	6.2	6.8
Khanwas/Dausa	Hand Pump	6.1	6.1	6.1	5.4	6.1	6.1	6.1	5.4	6.2
Chakharpatti/Dausa	Hand Pump	6.8	5.7	5.7	5.2	6.8	5.6	5.7	5.2	6.9

Materials and Methods

Analysis of Water

Water samples were collected from 98 villages periodically and physico-chemical characteristics were studied according to methods suggested by APHA, AWWA, and WPCF (1985). pH, EC, TDS, Chlorides, Total Hardness, BOD and Fluoride contents were analyzed. Fluoride contents were determined with the help of selected Ion Meter (Model # 407 or Model No. 407) using Total Ionic strength Adjustment Buffer (TISAB).

Analysis of Vegetables

Fluoride concentration was estimated from seven selected villages. Wheat, potato, and tomato samples were collected and analyzed by selected Ion Meter.

Human Health

Personal observations were made and help of dentists and medical practitioners, technicians of diagnostic laboratories and radiologist were sought.

Study Area

Dausa district is situated nearly 56 km away from Jaipur city. It lies between 27° 05' to 30°12'N latitude ad 75°00' to 78°17'E longitude (Fig. 1) Dausa district is in the semi-arid part of Rajasthan. High temperature, low rainfall, low relative humidity, high evaporation and transpiration rate are the main characteristic features of Dausa district. People of Dausa district use mainly ground water both for drinking and agriculture. Water contains high fluoride contents. (Fig. 2)

Results

Fluoride in vegetables

Fluoride concentration was estimated from the samples of the crop plants from seven selected villages. Wheat, potato and tomato were collected and analyzed. Wheat samples contained fluoride between 3.24 mg/l 14.2 mg/l. Potato samples contained fluoride between I.22 mg/1 to 2.92 mg/l. Tomato samples contained fluoride between 1.I0 mg/l to 4.19 mg/l (Table 1).

Fluoride in water samples

Water samples were collected from hand pumps and open wells from 98 villages of Dausa district. Water samples were analyzed for fluoride contents. The results of water analysis revealed that water samples contained fluoride ranging between 3.0 to I4.9 mg/l. None of the villages have fluoride concentration in drinking water less than 3.0 ppm. 24 villages have fluoride concentration in drinking water between 3.0 to 5.0 ppm. 74 villages have fluoride in the drinking water between 5 to I5 ppm. (Tables 2).

Fluorosis in Human Beings

In the present study survey of 98 villages and analysis of drinking water revealed that human beings are the worst sufferer. The inhabitants of the villages are bound to drink water with high fluoride contents and consume vegetables and other edible products grown in these villages where the agricultural fields are irrigated with water containing high fluoride concentration. Fluoride affects human health at dental, skeletal and Non-skeletal level, some time making human beings almost disable. In "*Bairwa Ki Dhani*" it was observed that almost every

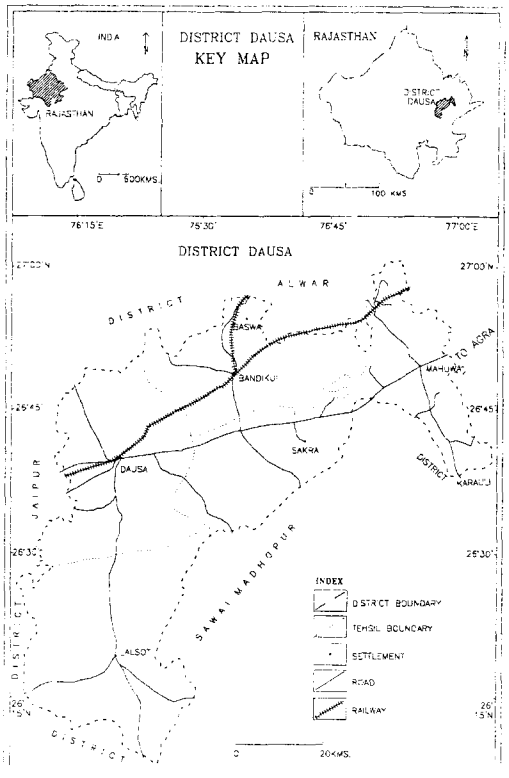

Fig. 1

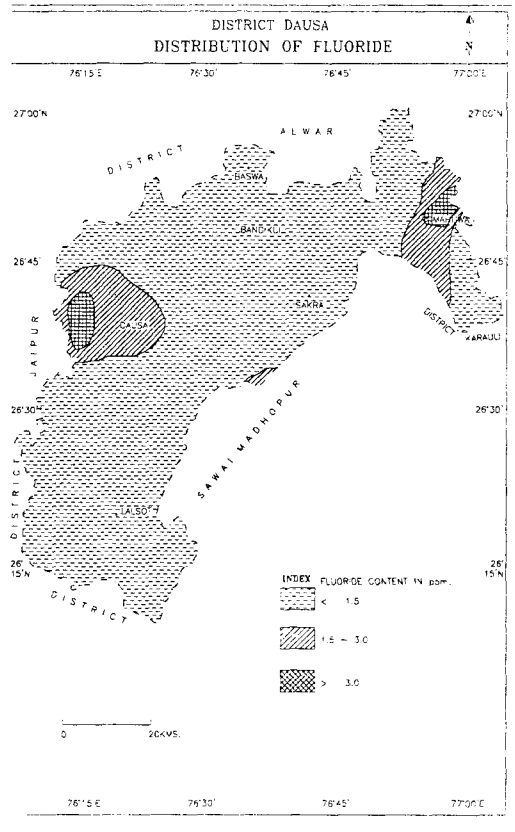

Fig. 2

individual was affected by fluorosis. Those who were living in this village since their birth and attained an age of 50-55 yrs were acutely suffering from fluorosis. Young ladies who came to this village after their marriages were also observed. It was found that these ladies were also suffering from fluorosis. However, the impact on the ladies was mild.

Dental Fluorosis

Fluoride is reported to be having very high affinity with calcium. It is scientifically proved, when drinking water with high fluoride above I.5 ppm is consumed, inevitably adverse impacts can be observed in the form of dental, skeletal and non-skeletal fluorosis. Thorough investigation was done to study dental fluorosis in children, young and elderly persons. Critical dental fluorosis in different grades were observed in the study area and these case were recorded. (Plate 1&2)

Plate 1: Naresh (Age 8 years)

Plate 2: Hanuman (Age 10 years)

Close-up photograph of Teeth of children with Dentalfluorosis in Bairwa Ki Dhani.

Plate 3: Gyarsi lal (Age 58).

Plate 4: Close-up photograph of severely affected legs.

Photograph of a farmer of Bairwa Ki Dhani suffering from flurosis.

Skeletal Fluorosis

Fluoride deposition starts on bones at undesirable places when water containing high fluoride is continuously consumed. The problem of immobility of joints and curving of bones was recorded. A large number of persons observed to be suffering from skeletal fluorosis in the study area (Plate 3 & 4).

Selected patients were taken to medical practitioners and radiologists for further investigations. The exact status of impact of fluoride on backbones legs and hands were recorded by taking appropriate X-rays with the advise of medical practitioners and radiologists..

Discussion

An investigation of dental and skeletal fluorosis in children, young girls and boys and elderly persons was carried out. It was found that people of Dausa in general and people of "*Bairwa Ki Dhani*" in particular were the worst sufferer belonging to all age groups. All grades of dental fluorosis were observed during the study period. Those, who came later to this place, also started developing skeletal, dental and non-skeletal fluorosis. (Gupta 1999 and Singh 2002) Kiritsy et.al (I996) reviewed that in few studies it was investigated that fluoride exposure from juices and juice flavored drinks manufactured with water caused severe fluorosis. In their investigation 532 juice samples were analyzed. The fluoride concentration ranged between 0.02 to 2.8 ppm. A study by Ismail (I990) was carried out to evaluate the difference in dental caries and fluorosis prevalence in 936 randomly selected life-long residents selected from public and private sectors in Canada.

Dental caries prevalence data collected by Johnston (I986) in Ontario health units from I95I to I956 and data collected by almost I00 investigators in Ontario health Units during the years 1972 to I984 for children aged five, seven, nine, eleven and thirteen years were analyzed by various statistical methods to determine the rate of decline of caries over the years. A study by Maupome et al (200I) revealed that the prevalence of caries (assessed in 5927 children in grades 2,3,8 and 9) decreased over time in the fluoridation ended community. Baelum et al (I986) carried out a study with a purpose to assess whether the degree of severity of enamel changes in a population exhibiting rather severe dental fluorosis may be related to post eruptive tooth age and to describe the clinical manifestations of the enamel destructions. All permanent teeth in I02 children aged I0-15 who were born and reared in a 2 ppm fluoride area of Kenya were examined for dental fluorosis, using the TF-Index. Clinically at time of eruption, all teeth appeared chalky white, but already prior to coming into occlusion discrete pits were formed. Chan et al (I990) have reviewed that recent studies have demonstrated that the incidences of dental fluorosis have increased.

As it is clear from the work done in this field by earlier workers that consumption of water with high fluoride contents causes dental as well as skeletal fluorosis. In the present study also patients were observed and subjected to thorough investigations by medical practitioners and radiologists. People suffering from fluorosis in this study area were interviewed for their dietary habitats, pain in joints and other parts of body, about movements. Bones of hands and feet were observed with curves and backbones

stiff with lot of filling materials. In the present study, cases of crippling disease, (skeletal fluorosis) were investigated and recorded.

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