RESEARCH BRIEF

Child Fluorosis in Chhattisgarh, India: A Community-based Survey

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Objectives: To assess the prevalence and type of fluorosis among children from randomly selected villages of Chhattisgarh, and its relationship with fluoride levels in drinking water.

Methods: A community based door-to-door survey was conducted in the sampled villages of seven districts of Chhattisgarh state during the year 2013-14. The field case definitions were used for labelling types of fluorosis. The fluoride concentration in drinking water was estimated by ion selective electrode method.

Results: The prevalence of fluorosis ranged between 12 to 44% in children of surveyed districts. The fluoride levels in drinking water of selected villages were in the range of 0.1-9.0 ppm.

Conclusion: Dental and skeletal fluorosis is endemic among children in the surveyed districts of Chhattisgarh State, and is related to drinking water with fluoride content of ≥1.5 ppm.

Keywords: *Fluorosis, Genu Varum, Kyphosis, Skeletal deformities*.

Drinking water with fluoride content >1.5 mg/L may cause fluorosis. The effects range from mild dental fluorosis to crippling skeletal fluorosis as the level and period of exposure increases [1]. About 62 million people, including 6 million children are at risk of fluorosis in India [2]. The present study was undertaken to determine the extent of fluorosis among children in surveyed villages of Chhattisgarh state, where groundwater is the major source of drinking water.

METHODS

Community-based, cross-sectional, door-to-door survey was done in seven villages, randomly selected from seven districts of the Chhattisgarh State, during May 2013 to January 2014. Initially, a village map, as per hamlets was prepared with the help of key village members and ASHA (Accredited Social Health Activist) for population listing and water source mapping. Informal meetings were held between local leaders and health officials. The purpose and the period of the survey, technique to be used and its significance were explained to them. Announcement was made in each village to get cooperation of villagers with the aim to cover the entire village population. The survey teams, each consisting of three to four members, headed by a doctor, conducted door-to-door survey of the whole village to cover the entire population. All available house members were clinically examined. The information was filled in the pre-designed form. Field operational case definitions (***Box* I**) were used for labelling dental fluorosis and skeletal fluorosis. A follow-up visit was made on the evening of the day to cover the houses which were found locked and persons who were found absent on the day of the survey. The listing, labelling and collection of water samples were done on the final day of the survey. These water samples were sent to a Public Health Engineering (PHE) laboratory for estimation of fluoride levels. Water fluoride levels were tested by ion selective electrode (4 star Orion) using TISAB-3 ionie solution. After analysis of water samples, a mapping of the fluoride content in the separate drinking water sources along with the affected households was taken in each hamlet of the surveyed village. A *de jure* approach was followed for school-going children for enumeration during analysis purpose.

BOX I FIELD OPERATIONAL CASE DEFINITIONS OF FLUOROSIS

A. *Dental fluorosis*: Teeth exhibit clinical signs showing mottled enamel, chalk white, yellowish brown or brownish black, horizontal streaks over teeth's.

B. *Genu varum*: Outword bowed Legs usually around knee in the standing position.

C. *Genu valgum*: Inward bowing of legs in standing position.

D. *Kyphosis*: Forward bending of spine, with fixed, rigid thoracic cage

RESULTS

A total of 1414 (90%) houses in 38 hamlets with population of 7575 (84.5%) were covered in sampled villages of seven districts of Chhattisgarh State. Socioeconomic status of the village was heterogeneous and the villagers mainly depended on agriculture and casual labor. Out of total population covered, 3390 (44.7%) were children less than 18 years of age; 1764 (52%) were males. Out of total children, 740 (21.8%) were aged less than 5 years, 1404 (41.4 %) were between 6-14 years of age and 1248 (36.8%) were 15-18 years of age. Fluorosis affected 33.6% boys and 29.9% girls (***Table* I)**. Prevalence of dental fluorosis was 21.4%. The prevalence of fluorosis among children was highest in *Kanker* (44%) district followed by *Korba* (29%) and *Surguja* (23%) (***Table* II)**.

In the surveyed area, the children were exposed to fluoride levels ranging between 0.1-9.0 ppm with mean (SD) of 2.2 (2.1) ppm in drinking water. Water samples of all wells had fluoride level less than 1.5 ppm (range 0.1-1.2 ppm) while 54% of hand pumps had fluoride level more than recommended.

DISCUSSION

The overall prevalence of fluorosis among children was found to be 24.7%, with fluoride level of drinking water ranging from 0.1 to 9.0 ppm. The relationship between the level of fluoride in drinking water and the prevalence of fluorosis varied from place to place.

Other studies, mostly undertaken among school children, had reported higher prevalence [3-6]. Dental fluorosis in this population was significantly higher in boys than girls (P>0.05). These findings are in accordance to the studies undertaken in India as well as in other countries [7-9]. Prevalence of manifestation of skeletal fluorosis was lower than other provinces in India [10]. This might be due to different water sources used at different times, and difference in water consumption. Possibility of other factors such as nutritional status of children, climate conditions, individual susceptibility, biological response, duration of exposure, dissolved salts in the water might also have played a role [11]. Common deformities of genu varum (38.1%) genu vulgum (6.3%) were also as reported by others [3,11].

The prevalence of fluorosis was not found to be consistently related to water fluoride concentrations in all the surveyed hamlets. This may be due to the habit of frequently changing the drinking water source by the children among the hamlets and school. Of the 199 drinking water sources in the surveyed hamlets that were analyzed for fluoride, the mean fluoride level was higher than the desirable limit of 1.5 ppm for safe drinking water.

TABLE II DISTRICT-WISE PREVALENCE OF FLUOROSIS AND WATER FLUORIDE LEVELS (Year 2013-14)

District	*Fluorosis cases No. (%)*	*Water fluoride level (in ppm) Mean (SD); Range*
Ambikapur	72 (18.0)	3.8 (1.9); 0.4-6.8
Balod	91 (18.1)	2.5 (2.0); 0.5-2.2
Balrampur	50 (12.1)	2.0 (1.9); 0.2-4.0
Bastar	183 (24.8)	3.0 (2.6); 0.1-7.3
Kanker	227 (44.0)	2.2 (0.1); 0.5-2.8
Korba	126 (29.0)	2.8 (2.2); 0.1-3.5
Surajpur	89 (22.9)	3.3 (1.7); 0.2-9.0

TABLE I PREVALENCE AND TYPE OF FLUOROSIS AMONG CHILDREN IN SURVEYED DISTRICTS

Type of fluorosis	*6-12 y*		*13-18 y*		*Total No. (%)*
	Female (No.)	*Male (No.)*	*Female (No.)*	*Male (No.)*	
Dental fluorosis	194	191	176	164	725 (21.4)
Dental fluorosis and Genu valgum	6	8	3	6	23 (0.7)
Dental Fluorosis and Genu varum	5	6	5	11	27 (0.8)
Genu valgum	9	4	2	6	21 (0.6)
Genu varum	7	6	9	17	39 (1.2)
Genu varum and Kyphosis	0	0	0	1	1 (0.0)
Kyphosis	0	0	0	1	1 (0.0)
Genu valgum and Kyphosis	0	0	0	1	1 (0.0)
Total	221	215	195	207	838 (24.7)

WHAT THIS STUDY ADDS?

- A high prevalence of fluorosis was documented among children in the study area, with consumption of water with more than recommended fluoride level.

Household and school water defluoridation along with improved nutrition is recommended for amelioration of fluorosis in these villages. These villages would be the priority areas where the fluoride safe water supply schemes should be provided in the future.

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