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Effect of Drinking Water Fluoride Toxicity on Children's and Adult In The villages of Amravati District, Maharashtra

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Abstract: *Fluoride is found in all natural waters resources to some degree. It can be extremely high in groundwater, depending on a number of factors, such as the types of rocks and minerals of that region. Drinking water is the one of the major source of fluoride consumption in India. Except that a variety of vegetables and fruits, grains, meat, poultry and fish (especially canned fish), milk and tea; most natural foods have minor levels of fluoride, but there are a few exceptions. Tea leaves, processed foods and beverages such as sodas, juices, sports drinks, baby foods, etc., are often high in fluoride. Fluoride toxic effects that contribute to multiple health problems, including lowered IQ, dental fluorosis, bone weakness and fractures, immune and endocrine dysfunction.*

Key: Environmental Conditions, Water Analysis, and Morphological symptoms,

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I. Introduction

Among the water quality parameters, fluoride is one of the minor constituents in natural water. Fluoride, an electronegative element, is highly reactive, therefore, almost never occurs in elemental state in natural water. The origin of fluoride in ground water is through weathering of alkali, igneous and sedimentary rocks. The common fluoride bearing minerals are Fluorspar (CaF_2), Cryolite (Na_3AlF_6), Fluor-apatite ($Ca_3(PO_4)_2Ca$ (FCL $)_2$), fluorite (CaF2) is the principle bearer of fluoride and is found in granite, granite gneisses and pegmatite (Deshmukh et al., 1995 and Rao, 2009),Apart from natural sources, a considerable amount of fluoride may be contributed due to anthropogenic activities. Burning of coal, manufacturing process of aluminum, steel, bricks, fertilizers industries, often contain fluoride as an impurity and are being leached down to the ground water (Deshmukh et al.,1995; Anderson et al., 1991; Smith and Hodge, 1979; Tailor and chandel, 2010).The high level of fluoride in drinking water beyond the permissible limit (IS;10500 and WHO, 1996) has toxic effect, while its optimum level shows beneficial effect in reducing dental carries. Though fluoride enters the body through different water resourses, food, industrial exposure, drugs, cosmetics, tooth pest etc., Drinking water is the major source (75%) of daily intake Sarala and Rao, (1993). Major health problems cause by high level of fluoride are dental fluorosis (teeth mottling), skeletal fluorosis and deformation of the bones in childrens as well as adults (Ramanaiah et al., 2006).

In some parts, India has major public-health problems induced by use of groundwater as a source of drinking water having excess fluoride. Due to different types of natural and manmade activities groundwater resources are under threat in some parts of the country. Small quantity of fluoride is an essential component for normal mineralization of bones and prevents dental enamel. However, excess concentration may result in slow, progressive scourge known as fluorosis. More than 20 developed and developing nations are suffering from fluorosis. In India, fluoride in drinking water was first reported at Nellore district of Andhra Pradesh in 1937 and then considerable works have been done in different parts of India.

At present, it has been estimated that fluorosis is widespread in seventeen states of India indicating that endemic fluorosis is one of the most acute public health problems of the country. More than 66 million people are estimated to suffering from fluorosis, among which 6 million children are below 14 years of age in India alone. Fluorine is widely distributed in earth's crust and exists in the form of fluorides. The natural concentration of fluoride in groundwater depends on the geological, chemical and physical characteristics of resources, types of the soil and rocks, temperature and the action of other chemical substances.

Fluoride is completely absorbed by the gastrointestinal tract and the absorbed fluoride is rapidly distributed throughout the body. Since fluorine is highly electronegative element, it has a strong tendency to get attracted by positively charged calcium ions in teeth and bones and excessive intake result in pathological changes in teeth and bones, such as mottling of teeth or dental fluorosis followed by skeletal fluorosis. BIS (Bureau of Indian Standards) permissible limit for fluoride is 0.6-1.2 mg/lit and WHO (International Standards for Drinking Water) is 1.5 mg/lit. Thus, a large amount of fluoride gets bound in these tissues and only a small

amount is excreted via urine, faeces and sweat. Skeletal fluorosis is observed when drinking water contains 3-6 mg of fluoride per liter and developed as crippling skeletal fluorosis when drinking water contains over 10 mg of fluoride per liter. Other sources of fluoride poisoning are food, industrial exposure, drugs, cosmetics, etc. WHO, has stated that India and China are the most affected countries to fluoride exposure.

Study Area:

We are selected the three villages of Amravati district,under Bhatkulli Tahasil situated in N-W part of the Amravati city nearly 18 km. away. The longitude of study area is 77˚38'11.2"E and latitude is 20˚56'40.2"N which include in map of survey of India toposheet No. 55 L/12. These villages are Alangaon, Kund and khurd.

II. Material and Methods:

II. Methodology of study:

The method of work can be divided in two parts. First is the field work and another is laboratory work. The field works have been done in Alangaon, Khurd and Khund villages. The samples were collected from various locations of these villages. The samples were collected in air tight bottle and sealed by giving the sample number on bottle. After collecting the samples we have to do chemical analysis in laboratory, Such as pH, total hardness and the fluoride concentration. Results after the physio- chemical analysis of water sample is given below in Table no -1, Table 2 and Table 3 respectively. Following are the analysis has done to found the parameters from the water samples.

Sampling Process:

Water samples was collected from fifteen different areas located in around study areas in the brown glass bottles with necessary precautions such as label the sample bottle with source, location, date and time.. All the chemicals used were of AR grade. Double distilled water was used for the preparation of reagents and solutions. The water quality parameters considered for the examination in this study are Temperature, pH, Total hardness, Sulphate, Phosphate contents measured by water analysis kit an manual methods. Calcium hardness of water was estimated by titration methods.

Analysis of sample:

The samples of drinking water were collected for analysis of fluoride concentration at the different site from tap water, well water and boar water. The analysis of fluoride ions would be expressed as parts per million (ppm) or mg/l. The obtained water samples were filtered. One part of filtrate from each water sample was mixed with one part TISAB buffer. At the same time five fluoride standards varying between 10-1M and 10-7M were prepared in 50% TISAB buffer and a calibration curve was set from where the fluoride concentration of the sample was determined with the use of a combination fluoride ion selective electrode. Three different fluoride dilutions as a unknown were made from each water sample, the fluoride concentrations in each determined.

III. Result and Discussion:

Analysis of Water Samples:

The physico-chemical data of the hand pump, tap water and bore wells water sample collected in Feb 2016 and Mar- 2016are recorded in table 1, Table 2 and Table -3 respectively. The results of the samples vary with different collecting places because of the different geological nature of the soil and anthropogenic activity.

Temperature: In the present study temperature ranged from 32.30C to 39.00C.

PH: In the present study pH ranged from 7.5 to 8.71. The tolerance pH limit is 6.5 – 8.5.

Calcium Hardness: The calcium hardness ranged from 8.02 to 88.70 mg/L. The tolerance range for Ca hardness is 75 – 200 mg/L. All the sampling stations (the hand pump, tap water and bore-well water wise concentration of fluoride) were categorized as follows;

Category 1 - Fluoride concentration below 1.0 mg/l.

Category 2 - Fluoride concentration between 1.0-1.5 mg/l.

Category 3 - Fluoride concentration between 1.5-3.0 mg/l.

The concentration of fluoride distribution in hand pump, tap water and bore-well water as shown in table 1, table 2 and table 3 respectively. The coloured comparative charts and bar charts are also prepared as shown in figure- A,B, and C. Fluoride concentration in hand pump, tap water and bore-well water samples in the study area of Amravati dist. ranges from 1.18-3.02 was recorded. In the study area maximum concentration (3.02 mg/l) was recorded at Khurd village in Amravati district Maharashtra.

The present survey reveals that out of 18 hand pump, tap water and bore-well water samples in 3 villages have fluoride concentration more than 1.5 mg/l and fall in category 3, which is above the maximum permissible limit of standards for drinking water (BIS,WHO). The concentration of fluoride is less than 1.0 mg/l it may be beneficial for preventing dental problems. In the study area percentage of fluoride was significant therefore it

may be most of the children's are suffering from dental fluorisis was observed in plate no 01,02 and 03 as well as some old people are suffering from skeletal fluorisis (plate no.01). At this concentration, mottled enamel and in some cases, the pre stage of skeletal fluorosis has been observed. The intake of fluoride through drinking water from different sources per day of their population in this was very high and it may be cause dental as well as skeletal fluorosis patient was observed.

The result indicate that study area of Amravati district shows significant concentration of fluoride in the different sources than other area presented in table 1,2 and 3 from bar charts as shown in figure A,B and C, it is cleared that among 3 locations of Amravati district i.e, Alangaon, Kund, and Khurd. These villages are under the dental and skeletal fluorosis.

Dental fluorosis grade: grade-0: healthy teeth, grade-1: yellowish with white opaque, grade-2: brown stains, grade-3: chipped edges with brown stains, grade-4: dark brown with loss of teeth.

Skeletal fluorosis grade: grade-1: mild joint pain, grade-2: restricted movements of joints due to stiffness, grade-3: deformities of bones leading to crippled or bed ridden.

The results also indicate the persistence of high fluoride concentration in ground water, hand pump , tap water and bore-well water are the main sources of drinking water from 3 villages in Amravati dist.

IV. Discussion:

The mean fluoride content of the drinking water sources of Alangaon, Khurd and Kund was higher than the permissible level of 1 ppm according to WHO.1 Although fluoride levels in the water from the three sources of drinking water ranged from 1.18 to 3.02 mg/l. Earlier studies have indicated that the incidence and severity of chronic fluoride intoxication are greatly influenced by socio-economic, climatic, and nutritional status. The relationship between the levels of fluoride in drinking water and the incidence of dental fluorosis vary from place to place. Enamel mottling at 0.5 ppm and 0.9-1.0 ppm fluoride levels has been reported. At 6.0 ppm, 100% prevalence of dental fluorosis has been reported. Choubisa *et al* have observed a prevalence of 25.6% and 84.4% of grade II dental fluorosis in children at fluoride levels of 1.4 ppm and 6.04 ppm, respectively. In our survey report most of the children's of all these three villages are suffering from dental fluorosis.

Several workers have reported skeletal and crippling fluorosis at fluoride levels above 1.4 ppm and 3.0 ppm respectively. Here an overall prevalence of skeletal fluorosis with some symptoms are showed among children and old peoplesl fluoride level of more than 3.00mg/l was observed. The prevalence of skeletal fluorosis was marginally higher in males than female. Fluoride toxicity affects childrens more severely and after shorter exposure to fluoride than adults. In the present study, we found the prevalence of fluoride toxicity and associated deformities were showed in the children, low IQ level and skeletal fluorisis in old age people. Some of the adults have visible symptoms of skeletal toxic effects. However, a few of them complained of vague back pain and stiffness.

Fluoride:- The % of fluoride in mg/l in STUDY AREA OF different water sources was ranges from 1.18 - 3.02 mg/l.

Result of physiochemical parameters are given in Table 1, 2 and 3

Table No. 1
ALANGAON

Sr. No.	PARAMETER	UNIT	REQUIREMENT (MAX) IS:105000:2012	PERMISSIBLE LIMIT(MAX) IS:105000:2012	METHOD OF TEST	Source of Sample		
						HAND PUMP WATER	Tap Water	BOREWELL WATER
1	P^H AT 32˚C	-	6.5-8.5	No Relaxation	IS:3025 (PART-11)	8.60	7.94	7.90
2	TEMPERATURE	˚C	31-44	No Rel.	Thermo-metric	34	37	39
3	Total Hardness (AS $CaCO_3$)	Mg/l	200	600	IS:3025 (PART-21)	700	820	880
4	FLUORIDE (AS F^-)	Mg/l	1.0	1.5	IS:3025 (PART-60)	2.21	1.81	1.83

% of fluoride in mg/l in STUDY AREA OF different water sources in ALANGAON was ranges from 1.18 -2.21 mg/l.

Table No. 2 **KUND**

Sr. No.	PARAMETER	UNIT	REQUIREMENT (MAX) IS:105000:2012	PERMISSIBLE LIMIT(MAX) IS:105000:2012	METHOD OF TEST	SOURCE OF SAMPLE		
						HAND PUMP WATER	Tap Water	BOREWELL WATER
1.	P^H AT 27˚C	-	6.5-8.5	No Relaxation	IS:3025 (PART-11)	8.4	7.50	7.7
2.	TEMPERATURE	˚C	31-44			34	37	39
3.	Total Hardness (AS $CaCO_3$)	Mg/l	200	600	IS:3025 (PART-21)	690	790	730
4.	FLUORIDE (AS F^-)	Mg/l	1.0	1.5	IS:3025 (PART-60)	2.45	1.77	1.9

% of fluoride in mg/l in STUDY AREA OF different water sourcesin Kund was ranges from 1.77 -2.45 mg/l.

Table No. 3 **KHURD**

Sr. No.	PARAMETER	UNIT	REQUIREMENT (MAX) IS:105000:2012	PERMISSIBLE LIMIT(MAX) IS:105000:2012	METHOD OF TEST	RESULT		
						HAND PUMP WATER	Tap Water	BOREWELL WATER
1	P^H AT 27˚C	-	6.5-8.5	No Relaxation	IS:3025 (PART-11)	8.1	7.50	7.61
2.	TEMPETATURE		31-44			34	37	39
3.	Total Hardness (AS $CaCO_3$)	Mg/l	200	600	IS:3025 (PART-21)	630	790	730
4.	FLUORIDE (AS F^-)	Mg/l	1.0	1.5	IS:3025 (PART-60)	3.02	1.77	1.96

% of fluoride in mg/l in STUDY AREA OF different water sources in Khurd was ranges from 1.77 -3.02mg/l.

Plate No. 1

Plate No. 2

Plate No. 3 Photographs from village Khurd

V. Conclusions :

In present studied reveals significant concentration of fluoride was observed in drinking water from different sources such as hand pump, tap water and bore-well in this study areas. According to the WHO if concentration was more than 1.5mg/l then children's are suffering from dental fluorosis. In addition to typical manifestations of dental and skeletal fluorosis, the photographic pictures of the children's and old age peoples are of these three villages resembles to slandered clinical and radiological picture as an expression of environmental fluoride toxicity. In view of high fluoride content of the bore well, hand pump and tap water was associated with the fluoride toxicity among the children's and old peoples, our team has advised the local administration to provide an alternative drinking water supply.

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