Eco. Env. & Cons. 30 (July Suppl. Issue) : 2024; pp. (S166-S170)
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ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2024.v30i04s.028

A Study on Fluorosis Health Problems in Mashihal Village: An Ongoing Challenge to Public

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(Received 19 October, 2023; Accepted 20 December, 2023)

ABSTRACT

Fluorine is widely dispersed in nature in the form of fluoride. It is required for development and growth of the body. But excessive consumption of fluorides in different forms may lead to development of fluorosis. In the present study Mashihal village, Raichur District was selected to evaluate human health risks of fluoride contamination in Groundwater samples to understand its suitability for drinking purpose. In addition to this, health risks of prolonged ingestion of high fluoride were evaluated by standard survey and questionnaires method. The obtained results witnessed that in this village, people suffering from Dental, Skeletal and non-skeletal fluorosis. Groundwater chemistry is mainly controlled by presence of types of carbonates and weathering of rocks. Consequently the results reveal that the fluoride concentration in groundwater samples ranged from 4.6 to 6.4 ppm in Mashihal, which was significantly higher than the recommended limit of BIS (Bureau of Indian Standards) 0.5-1.5 mg/l. While low levels of fluoride help strengthen and protect tooth enamel, moreover much fluoride can cause dental fluorosis—a discoloration of teeth, usually with opaque white marks, lines, or mottled enamel and poor mineralization. Thus, Population of this area is at very high risks of chronic toxicity by excess fluoride intake. Therefore, there is an urgent need to supply of safe drinking water to public.

Key words*: Fluoride, Fluorosis, Groundwater, Mashihal Village*

Introduction

Water is generally considered a "free good" that is abundantly available and unlimited supply given that three-fourth of the earth is covered with water. But the reality, population growth and rapid urbanization, increasing comfortable circumstances and living standards, industrialization and climate change are globally increasing the demand for water. Therefore, Sustainable groundwater supply is among the most critical issue in the world. Billions of people worldwide are dependent on groundwater resources for drinking purposes. However, Quality and availability of groundwater are persistently altering due to both natural and anthropogenic causes (Rashid *et al.*, 2019). Among the various water contaminants fluoride is an important toxic contaminant that causes serious health risks and has received remarkable attention (Rashid *et al.*, 2019). It is more toxic than lead but less toxic than arsenic (Chaitanya *et al.*, 2014).

In groundwater, low or high concentrations of fluoride can occur depending on the nature of rocks and the occurrence of fluoride bearing minerals (Kim ambo *et al.*, 2019). For this reason, its origin is mostly geogenic in nature. In addition to the geogenic sources, fluoride enrichment in groundwater from anthropogenic sources such as chemical fertilizers, industrial effluents, sewage plant discharge, deposition from combustion sources and landfill

leachate (Iqbal *et al.*, 2021). Therefore fluoride in drinking water is suitable and beneficial at low concentrations but can create health concerns at higher concentrations. Long term drinking of water containing high fluoride content can result in softening of bones, ossification of tendons and ligaments, and abnormal bone growth in humans (Teutli *et al.*, 2013). Long term exposure to higher levels of fluoride (>1.5 ppm) in drinking water leads to serious health problems (Mirna *et al.*, 2014) like skeletal fluorosis, brain damage, osteoporosis, thyroid disorder, kidney diseases, cancer as well as staining of teeth (Ramesh *et al.*, 2017).

Fluorosis can be divided into four categories-Dental fluorosis, skeletal fluorosis, Non-skeletal fluorosis and Muscular fluorosis (Peeyush *et al.*, 2021).

Dental Fluorosis: It is a condition that causes changes in the appearance of tooth enamel. It may result when children regularly consume fluoride during the teeth forming years, from age 8 and younger (Gonzalez, 2021).

Skeletal Fluorosis: It is a metabolic bone disease caused by accumulation of fluoride and is generally associated with chronic exposure to fluoride contaminated groundwater, a phenomenon endemic to developing countries. Individuals with skeletal fluorosis may have bowed legs, knocked knees or sclerosis. Common symptoms such as joint pain due to skeletal fluorosis are often misdiagnosed as they present similarly to other joint or bone diseases such as arthritis. In the final stage, the patient is left crippled (Madhuri, 2016).

Non-Skeletal Fluorosis: It is an earlier manifestation of fluorosis seen as gastrointestinal complaints etc and may overlap with other diseases leading to misdiagnosis. The symptoms includes abdominal pain, Excessive saliva, Nausea and vomiting are seen after acute high level exposure to fluoride (Sudhir *et al.*, 2010).

The aim of the present study is to assess health problems associated with fluoride exposure.

Materials and Methods

Study Area

In the present study, selected Mashihal Village in Devadurga taluk, Raichur district as a study area to assess the fluoride content and also health problems associated with fluoride exposure. Mashihal village is situated between Latitude: 16°38′08.37′′ N, Longitude 77°05′03.24′′ E and This village is generally dry with a temperature range from 27 to 30°C in winter and 40 to 42 °C in summer. The average annual precipitation is 597.7- 607.9 mm (Fig. 1).

Sample Collection: The groundwater samples were collected from different sampling points like Hand

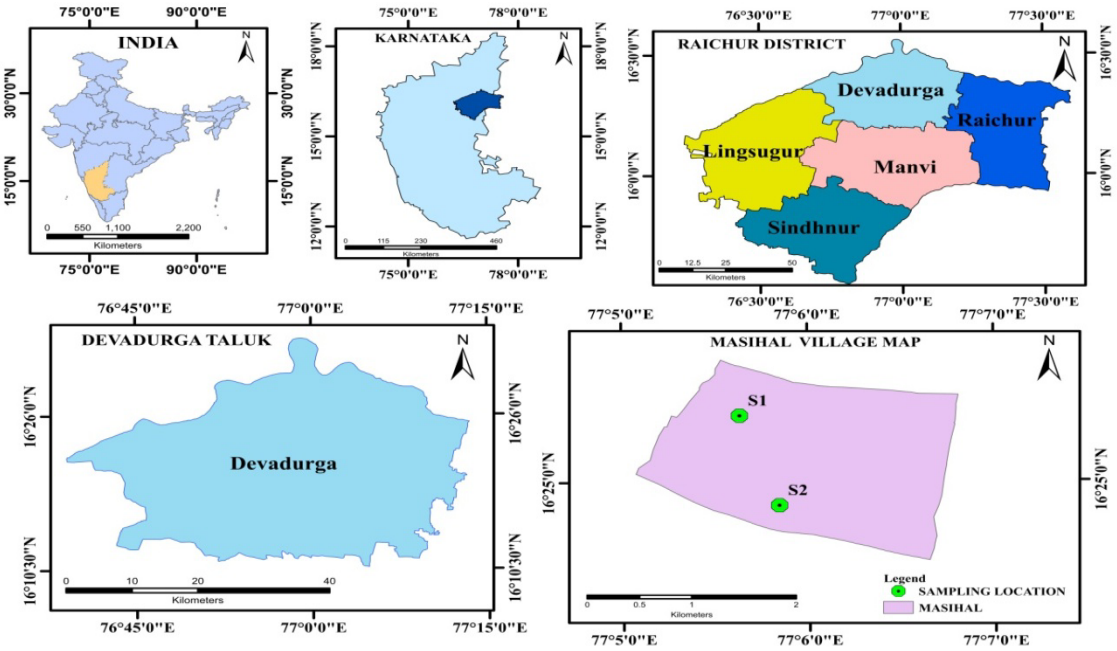

Fig. 1. Location map of study area

pumps and bore wells-the depth of which ranged from 90 ft to 135 ft (Devi *et al.*, 2012) where the groundwater is contaminated by fluoride. It was identified by sampling and testing with Fluoride ion Meter (Orion-advanced electrochemistry meter) by following Ion Selective Electrode method (Mendes *et al.*, 2020).

Questionnaire method: To investigate the public health problems associated with fluoride contaminated areas, appropriate standard Survey and questionnaire methods were followed. It consisting of a series of questions to gather information from respondents. This investigation was carried out face to face and collecting the data related to fluorosis disease in Mashihal village. Dental fluorosis was assessed on the basis of modified dean's index in this study. Chi square test is applied for statistical analysis. Skeletal fluorosis was assessed using the three field tests, namely

(a) Touching the toes without bending the knees
(b) Touching the chest with the chin, and
(c) Stretching the arms sideways and folding the arms to touch the back of the head

People who were incapable to perform the three simple diagnostic tests due to pain or stiffness in the neck or pain or stiffness in the shoulder joint and backbone, respectively, were considered to have skeletal fluorosis (Shruthi *et al.*, 2016).

Results and Discussion

In the present study, a total of 153 people who are living in the endemically fluorosed area of Mashihal village were evaluated (Fig. 1). People who participated in the study were in the age group of 10-80. Among this,6.53% of the people were between 1-9 years, 25.49% of the people were between 10-20 years,20.91% of the people were between 21-30 years,20.26% of the people were between 31-40 years, 11.76% of the people were between 41-50 years, 12.41% of the people were between 51-60 years, 1.96% of the people were between 61-70 years, 0.65% of the people were between 71-80 years (Table 1). Out of these, 47.05% were males and 52.94% were females (Table 2) dental fluorosis, Dean's index shows normal in 13.72% people, questionable in 16.99% of the people, very mild in 22.87% of people, Mild in 10.45% of the p% of the people (Table 3). Nearly 20.26% of people in this village suffering from skeletal fluorosis (Table 4). During the study, more number of people showed back pain, knee pain and difficulty to bend. Chi-square test was applied for statistical analysis.

Table 1. Health effects of fluoride on local community as age wise in Mashihal village

Age (Years)	*Mashihal*	
	n	%
0-9	10	6.53
10-20	39	25.49
21-30	32	20.91
31-40	31	20.26
41-50	18	11.76
51-60	19	12.41
61-70	03	1.96
71-80	01	0.65
81-90	0	0
Total	153	100

Fig. 2. Dental and skeletal fluorosis in Mashihal Village

Skeletal fluorosis and age were compared and *p* value was 0.00 and was statistically significant (Table 5). Skeletal fluorosis and sex were compared

Table 2. Health effects of fluoride on local community as sex wise in Guntral village

Sex	*Mashihal*	
	n	%
Male	72	47.05
Female	81	52.94
Total	153	100

Table 3. Prevalence of dental fluorosis on local community using Dean's index

Dean's index	*Mashihal*	
	n	%
Normal	21	13.72
Questionable	26	16.99
Very mild	35	22.87
Mild	16	10.45
Moderate	07	4.57
Severe	48	31.37
Total	153	100

Table 4. Prevalence of skeletal fluorosis on local community

Skeletal fluorosis	Health effects of fluoride	
	n	%
Present	31	20.26
Absent	122	79.73
Total	153	100

then p value was 1.035 and was not statistically significant and 52.3% of skeletal problems in females (Table 6). Dental fluorosis and skeletal fluorosis was compared and P value was found to be 0.008 and statistically significant (Table 7).

Conclusion

The groundwater sources in Mashihal village are highly contaminated with fluoride which is ranged from 4.6-6.4 ppm resulted into fluorosis. Dental fluorosis was present 31.37% and absent in 68.63 %. Skeletal fluorosis present in 20.26% and absent in 79.74%. Many people of this village had knee pain and difficulty in bending. Once the symptoms develop, treatment largely remains symptomatic. Prevention of is the best key to treatment. Hence, there is a need to take measures to prevent dental and skeletal fluorosis through supply of safe Drinking water by creating awareness to the public. Endemic

Table 5. Association between age and skeletal fluorosis on local community

Age group (Years)	Skeletal fluorosis				Total population (n)	Total percentage (%)	*p* value
	No		Yes				
	n	%	*n*	%			
1-9	10	6.53	0	00	10	6.53	**0.000**
10-20	39	25.49	0	00	39	25.49	
21-30	32	20.91	0	00	32	20.91	
31-40	29	18.95	02	1.30	31	20.26	
41-50	07	4.57	11	7.18	18	11.76	
51-60	04	2.61	15	9.80	19	12.41	
61-70	01	0.65	02	1.30	03	1.96	
71-80	00	00	01	0.65	01	0.65	
81-90	00	00	00	00	00	0	
Total	122	79.71	31	20.26	153	100	

*Since p < 0.05, there is a significant association between age and skeletal fluorosis.

Table 6. Association between sex and skeletal fluorosis

Sex	Skeletal Fluorosis		*Total*	Total %	P value
	Absent	Present			
Male	53	20	73	47.7	1.035
Female	69	11	80	52.3	
Total	122	30	153	100	

*Since p > 0.05, there is no significant association between age and skeletal fluorosis

Table 7. Association between dental fluorosis and skeletal fluorosis in Mashihal village

Dean's index	Skeletal fluorosis				Total	Total %	P value
	No	%	Yes	%			
Normal	40	26.14	8	5.22	48	31.3	0.008
Questionable	20	13.07	6	3.92	26	16.99	
Very mild	25	16.33	10	6.53	35	22.87	
Mild	13	8.49	2	1.30	15	9.80	
Moderate	7	4.57	1	0.65	09	5.22	
Severe	17	11.11	4	2.61	21	13.72	
Total	122	79.71	31	20.23	153	100	

Since p < 0.05, there is significant association between dental fluorosis and skeletal fluorosis

skeletal fluorosis developed due to intake of high fluoride contaminated water, long term exposure to fluoride, lack of nutrition, lack of concentration of trace elements and also impaired renal function.

Conflicts of Interest

There are no conflicts of interest**.**

Acknowledgements

The Authors are grateful to Kuvempu University for the financial support. Also grateful to District Health Office, Raichur, Karnataka for their support to carry out this work.

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