

Analysis of fluoride level in groundwater and fluorosis survey among school children in Pennagaram block, Dharmapuri district, TN, India

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Abstract

Fluorine is the highest electronegative of all elements. It is occurring in the form of fluoride in various minerals. The purpose of this study was to determine the fluoride levels in groundwater and to categorize the mineral constituents in soils and its supply fluoride ions to groundwater. Another aim of this study was predominantly of dental fluorosis among school children nearby Pennagaram area of Dharmapuri District, Tamil Nadu. In the present study 80 samples were collected during the month of September 2015 and analyzed for physico chemical parameters. The minimum fluoride concentration is found to be 0.09 mg/L in Neruppur and maximum 2.7mg/L in Pallipatti. Dental fluorosis survey is carried out high fluoride content area of groundwater in Pennagaram block among 4 schools of totally 657 students in the age group of 5 to 13 during the month of January 2016. More than 75% of the students were affected by dental fluorosis for the surveying schools. From the survey, it experiences an increasing trend in dental fluorosis among school children particularly recorded in 10 to 12 age group are affected by the maximum level. This study implies an urgent need to improve the quality of water and educate defluoridation of drinking water in affected areas to decrease the burden of fluorosis.

Keywords: Fluoride, Survey, Dental fluorosis, Groundwater, Pennagaram

Introduction

Fluoride is estimated to be the 13th most abundant ion in the earth's crust. The natural abundance of fluoride in the earth's crust is 0.06% to 0.09% and the average crustal abundance is 300mg/Kg. It occurs mainly as a free fluoride ion in ground water. Fluorine is highly reactive and has a strong affinity and it to combine with other elements to produce compounds called fluorides. Fluoride originates from the weathering of fluoride-containing minerals viz., fluorapatite, fluorospar, Biotite, etc., enters

to the surface waters and groundwater through direct contact (*Fawell, J et.al. and Tebut T. H. Y.*)

Presence of high fluoride bearing minerals in the host rock, the chemical properties and their interaction with water is considered to be the main cause for fluoride in groundwater. Chemical weathering under arid and semi – arid conditions, with relatively high alkalinity favors high concentration of fluoride in groundwater (*Vikas, C., et.al.*)

Fluoride in intake water has both helpful and harmful effects on human health. A small concentration of fluoride is essential for normal mineralization of bones and the formation of dental manners (Bell, M. C, Ludwig. T. G).The excess concentration of fluoride in groundwater causes dental caries. Most of the people suffer from fluorosis due to intake of fluoride concentration above 1.5mg/L which may cause dental fluorosis and intake of above 3.0mg/L which may cause skeletal fluorosis (Ripa, L. W, and WHO 1984). It also reduces the intelligence in children and is associated with exposure to high fluoride levels in food and drinking water (Li Z, et.al. and Zhao, L. B. et.al.)

The permissible limits of fluoride in drinking water by various organizations are given in table-1.

The problem of high fluoride contamination in groundwater has been reported by several researchers in India, China, Japan, Sri Lanka, Brazil, Malawi, North Jordan, Ethiopia, Canada, Norway, Kenya, South Carolina, etc., (Karthikeyan, K, et.al and Brindha, K, et.al).

In India 62.5 million people are suffering from disorders of teeth or bones through fluorosis. Seventeen States in India have

been acknowledged as endemic for fluorosis and Tamilnadu is one of them (Susheela, A. K).

In Tamil Nadu, the highest concentration of fluoride in groundwater is found to be in Dharmapuri and salem District, closely followed by Coimbatore, Madurai, Trichy, Dindukal and Chidambaram district. The districts having low fluoride are Thirunelveli, Pudukottai, and Ramnad districts (Sendesh Kannan, K. et.al). The district wise fluoride status in Tamil Nadu is presented in table-2.

Study area

The study area, lies between the longitude of 77°50'53" to 77°52'43" and North latitude of 11° 53'43" to 12 °19'49"covering an area of 1096.22 km². In these, Plain area covers an area of 604.48 Km² (Figure-1). The study area falls in Pennagaram block, Dharmapuri district of Northern Tamil Nadu. The major source for renew of water in this area is only the rainfall, during monsoon season. The normal rainfall is 902.1 mm. During 2013 – 2014 the actual rainfall of the district is 707.4mm. As the study area is underlain by the Archaean crystalline rock, groundwater may occur in the fractured rocks.

Table 1: The permissible limit of fluoride in drinking water by various organizations.

S. No	Name of the organizations	Permissible limit of fluoride (mg/L)
1	World Health Organization (WHO) International Standards for drinking water	1.5
2	Bureau of Indian Standards (BIS)	1.0
3	The committee of Public Health Engineering(PHE), Govt. of India	1.0
4	Indian Council of Medical Research(ICMR), Govt. of India	1.0

Table 2: Status of Fluoride in various districts of Tamil Nadu.

S. No	Status	District
1	Severe	Dharmapuri, Salem
2	Moderate	Coimbatore, Madurai, Trichy, Dindukal, Chidambaram
3	Less	Thirunelveli, Pudukottai, Ramnad

The present study is to evaluate the impact of fluoride among school children's at

Pennagaram Block of Dharmapuri District, Tamil Nadu, India.

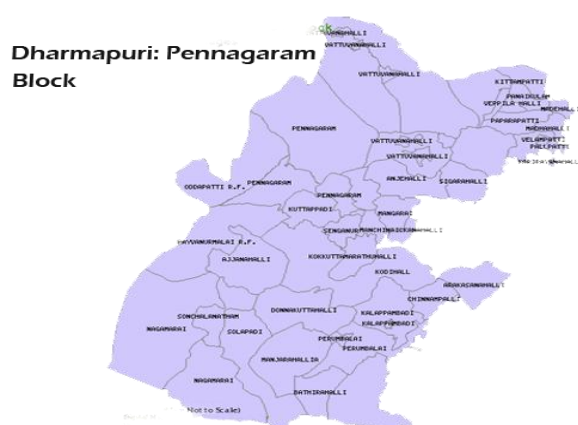
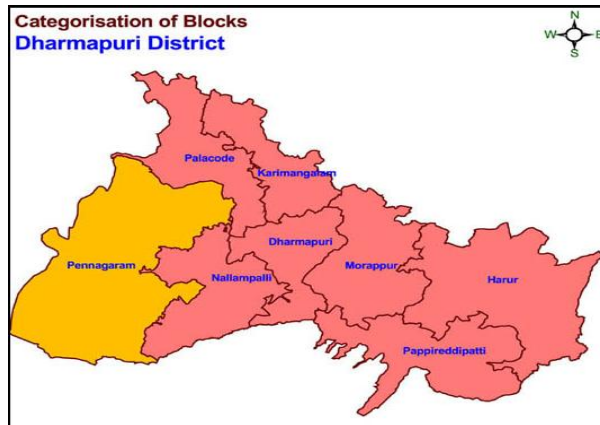


Figure 1: Study area.

Table 3: Name of the Sampling Stations.

S. No	Sampling Station	S. No	Sampling Station	S. No	Sampling Station
1	Malaiyur	28	Nallampatti	55	Perumbalai
2	Pickili	29	Mangarai	56	Boothanaickanahalli
3	Periyur	30	Vannathippatti	57	Thalihalli
4	Nagamarathupallam	31	Paruvathanahalli	58	Kalappambadi
5	Thirumalvadi	32	Kodiyur	59	Koppalur
6	Panaikulam	33	Erankadu	60	Senganur
7	Kittampatti	34	Aanaikkallanoor	61	Rajavur
8	Veppilaihalli	35	Mottuppatti	62	Nagamarai
9	Valloor	36	Kottavoor	63	Neruppur
10	Thotlampatti	37	Valakkamparai	64	Dhinnapellur
11	Aacharahalli	38	Naikanoor	65	Eariyur
12	Ettiampatti	39	Adaikkarisikottai	66	Pattukkarakottai
13	Palayapauparappatti	40	Kottuppatti	67	Ajjanahalli
14	Matheyhalli	41	Marukkarampatti	68	Vathalapuram
15	Pilapanaikanahalli	42	Madam	69	Manthamedu
16	Kochahalli	43	Puthur	70	Jakkampatti
17	Sitlakampatti	44	Agraharam	71	Donnakuttanahalli
18	Velampatti	45	Ootamalai	72	Aththimarathur
19	Pallippatti	46	Manjanaickanahalli	73	Begiumputhukadu
20	Manneri	47	Chinnakadamadai	74	Malaiyanoor
21	Sanjeevapuram	48	Pudhuppatti	75	Ramakondanahalli
22	Gandhipuram	49	Chinnamballi	76	Sithirappatti
23	Pikkampatti	50	Tholur	77	Sellamudi
24	Thalappallam	51	Kannampalli	78	Narasimedu
25	Nagathasampatti	52	Arakanahalli	79	Oothupallathur
26	Palinjacharahalli	53	Palaiyur	80	Poochoor
27	Sinnaperamanur	54	Kavakarankottai		

Materials and methods

Water samples from 80 locations were collected in the monsoon period from a depth of 5 to 30m below ground level from open wells and hand pumps in the down streams and the samples were analyzed as per the standards [APHA] for fluoride.

The dental fluorosis survey is made for the school children with proper guidance during the month of January 2016. After the survey the children are asked about the source of water, toothpaste, usual food habits, etc. The sampling locations are identified in figure-2.

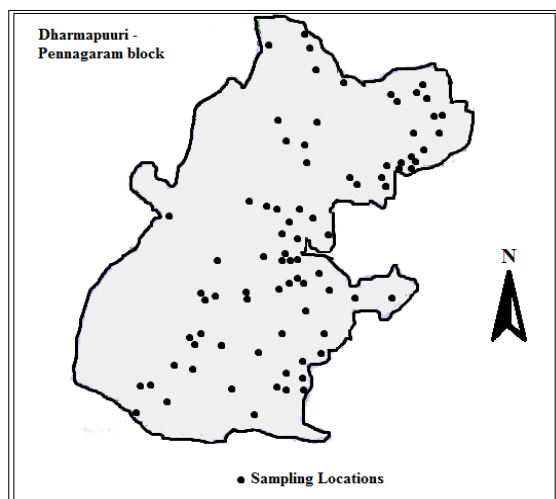


Figure 2: The Map shows sampling locations (Pennagaram block of Dharmapuri District, TN).

Results and discussion

The Dental fluorosis survey is carried out among 4 schools in Pennagaram block. The school survey results are given in table-3 & 4. The fluoride concentration in the study area varied between 0.09 and 2.70 mg/l. A total of 17 samples (21.25 %) exceeding the WHO guideline of 1.5 mg/l out of Eighty (Figure-3). The excess of fluoride content in groundwater is due to the availability and solubility of fluoride bearing minerals (Meenakshi, V. K. et.al).

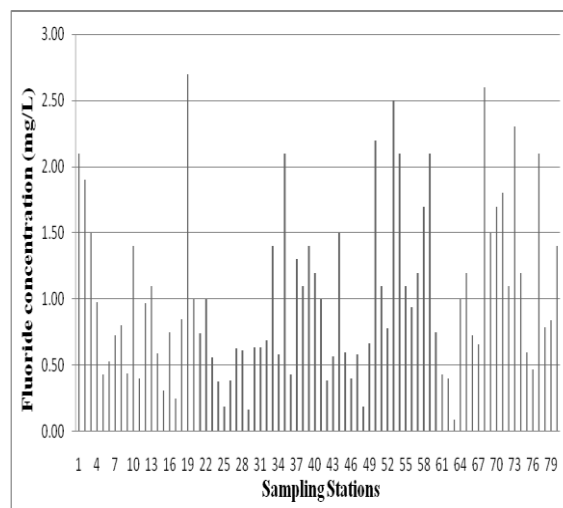


Figure 3: Shows the concentration of fluoride from various stations.

Table 4: Percentage of Victims affected by dental fluorosis in 4 schools (Pennagaram block).

S. No	Name of the School	Total number of Children	No of Victims Affected	% of Victims Affected
1	Panchayat Union Middle school, Puthukarambu, Pennagaram.	276	181	65.5
2	Panchayat Union Middle school, Kalappambadi, Pennagaram.	215	190	88.3
3	Panchayat Union Middle school, Jakkampatti, Pennagaram.	95	74	77.8
4	Panchayat Union Middle school, Moongilmaduvu, Pennagaram.	71	57	80.2
Total		657	502	76.4

Table 5: Percentage of dental fluorosis among school children in various age groups.

Age Group	5 – 7	7 – 8	8 – 9	9 – 10	10 – 11	11 – 12	12 – 13
No. of children examined	113	54	78	63	139	109	101
No. of children affected	41	40	62	51	123	98	87
% of victims	36.2	74.0	79.4	80.9	88.4	90.7	86.1

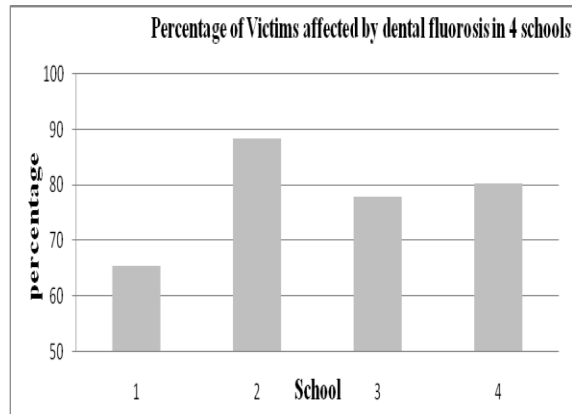


Figure 4: Percentage of victims affected by dental fluorosis in the study area.

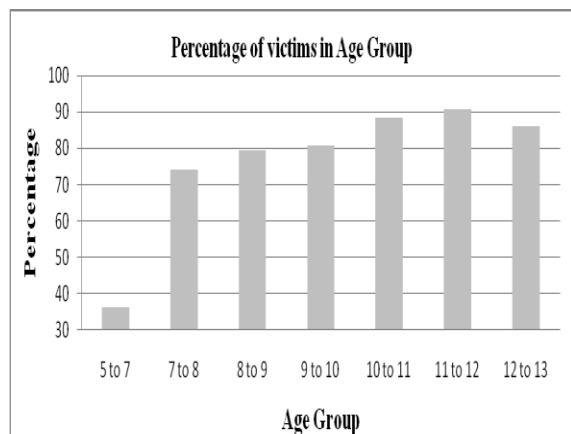


Figure 5: Percentage of dental fluorosis among school children in various age groups.

The results revealed that 10 – 12 age groups of children have affected maximum extent. Out of 657 children examined 502 children are affected by this disease. The percentages of victims are 76.4. Around 657 students are examined, only one child affected by skeletal fluorosis (figure-7).



Figure 6: Evidence of Dental fluorosis on 10 year old children in the study area.



Figure 7: Evidence of Skeletal fluorosis on 10 year old children in the study area.

Conclusion

This study establishes the high prevalence of dental fluorosis suggest that fluorosis is a major problem in the study area. The presentation acts as indicator to public health doctors, chemists, dentists, planners, administrators and water supply authorities. Compared to rural areas, the prevalence of dental fluorosis was higher in rural areas. From the survey, it experiences an increasing trend in dental fluorosis among school children particularly recorded in 10 to 12 age group are affected by the maximum level. This study implies an urgent need to improve the quality of water and educate defluoridation of drinking water in affected areas to decrease the burden of dental and skeletal fluorosis.

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