

Influence of Fluoride Level in Water on Dental Fluorosis Among School Children in Sivagiri Taluk, Tirunelveli District, Tamilnadu, India.

C.VELLATHURAI¹, P.SRI RENGANATHAN², V. SELVARAJ³ AND S. SELVARAJ⁴

¹ Department of Chemistry Sankar Polytechnic College, Tirunelveli – 627357

^{2*} Department of Chemistry, Rani Anna Govt. College for Women, Tirunelveli – 627008

³ Department of Chemistry, Morning Star Polytechnic College, Nagercoil – 629003.

⁴ PG & Research De Department of Chemistry, Sri Paramakalyani College, Alwarkurichi – 627412

Abstract

The fluoride level in drinking water and ground water and its relation to dental fluorosis was carried out among school children in Sivagiri taluk, Tirunelveli district Tamilnadu. Other parameters like pH, EC, CO₃²⁻, HCO₃²⁻, Cl⁻, SO₄²⁻, Ca²⁺, Mg²⁺, Na⁺, K⁺, RSC and SAR in drinking water were also studied. A cross sectional survey was carried out on school children of sixth to twelfth standard in Sivagiri taluk. Proportion of severity of dental fluorosis was calculated using Dean's index. Fluoride level in drinking water varied from 0.56 to 2.53 mg/l and from 0.90 to 2.52 mg/l in ground water. Out of 7857 children examined, 1824(23.21%) were affected by dental fluorosis. The purpose of the study is to analyze water sources with fluoride levels beyond WHO and Indian standards and formulate necessary procedures to reduce contamination of water and to follow proper diet to reduce dental fluorosis.

Keywords: Water, Fluoride, Dental, WHO, Fluorosis, Parameters.

Introduction

Fluoride, the smallest halide ion present in water plays a major role in rural drinking water system. It has no colour but distinct bitter taste. Fresh water contains 0.01 to 0.3 mg/l. It is due to the dissolution of Sodium Fluoride and Fluoro Silicates, anthropogenic activities of human beings and effluents from industries^{1,2}. It is also due to climate, host rocks and hydrogeology^{3,4}. 12 million tons of fluoride deposits are found in India^{5,6}. Fluoride level in ground water in India varies from 0.5 to 20mg/l^{7,8}. The permissible and safe limit of fluoride in drinking water is 1 to 1.5 mg/l. Lesser the amount of fluoride leads to dental caries. Excess amount of fluoride results in dental fluorosis. When it is in very high concentration (greater than 3 mg/l) it may cause skeletal fluorosis^{9,10}. Exposure to high fluoride level in food and water is associated with reduced intelligence in children¹¹. In India fluoride concentration in ground water is associated with igneous and metamorphic rocks. 62 million people including 6 million children in India are affected by dental fluorosis. Prevalence of dental fluorosis and its relation to fluoride in drinking water were studied in many parts of the world^{12,13,14}. Toxic effects of fluoride in Gujarat and relationship between fluoride in water and fluorosis among school children in the villages of Jhajjar district, Haryana, India have been studied^{15,16}. Direct link between fluoride and fluorosis have been established in many studies. Analytical results of water were compared with WHO guidelines in Rajshahi city of Bangladesh¹⁷.

The aim of this study was to find out the relationship between fluoride level, physico chemical parameters in drinking water and dental fluorosis in Sivagiritaluk, Tirunelveli district, Tamilnadu. Sivagiri taluk is located in northern west part of Tirunelveli district at 9.33⁰N and 77.43⁰E with an

elevation of 165m. It has a municipality, three town panchayats and many village panchayats. It has a population of two lakhs with 99,000 males and 1,01,000 females with a literacy rate of 67.47%. This part experiences a moderate rain fall. Important crops grown in this area are paddy, cotton, lemon and vegetables.

Materials And Methods

A pilot survey was conducted for collecting data regarding fluoride level in drinking water, ground water and dental fluorosis in Tirunelveli district. It was found out that Sivagiri taluk has more number of school children affected by dental fluorosis. Drinking water samples were collected in previously cleaned polythene bottles during winter season (the months of October and November 2013). The samples were tested for fluoride and other physico chemical parameters like pH, electrical conductivity, carbonate, bicarbonate, chloride, sulphate, calcium, magnesium, sodium, potassium, residual sodium carbonate (RSC) and sodium absorption ratio (SAR). Since drinking water system is from multiple sources, ground water samples were also collected from endemic fluoride areas and tested for fluoride. A pre-designed questionnaire was prepared to collect information from the school children regarding food habits, locations, hygienic habits and dental fluorosis. Dental examination was carried out among children who were present on the day of survey in a broad day light with the help of teachers. CFI was calculated using the individual scores and total sample size using Dean's inde.

Results

Initially drinking water samples were tested for fluoride and other physico-chemical parameters. Findings were presented in table 1. From the observed data it was found that a very few water samples show variation from WHO and Indian standards. Electrical conductivity of the samples was found to be in between 140 to 3660 $\mu\text{S}/\text{cm}$. Of these, six samples had electrical conductivity more than 1000 $\mu\text{S}/\text{cm}$. Amount of bicarbonate in drinking water samples were between 36.61 mg/l to 555.2 mg/l. Only one location Visvanathaperi has a maximum bicarbonate level of 555.2 mg/l. Chloride levels in these samples were from 17.7 mg/l to 609.9 mg/l. Levels of calcium and magnesium ion were found to be within the range of WHO guidelines. Other parameters were found to be within safe level.

Fluoride

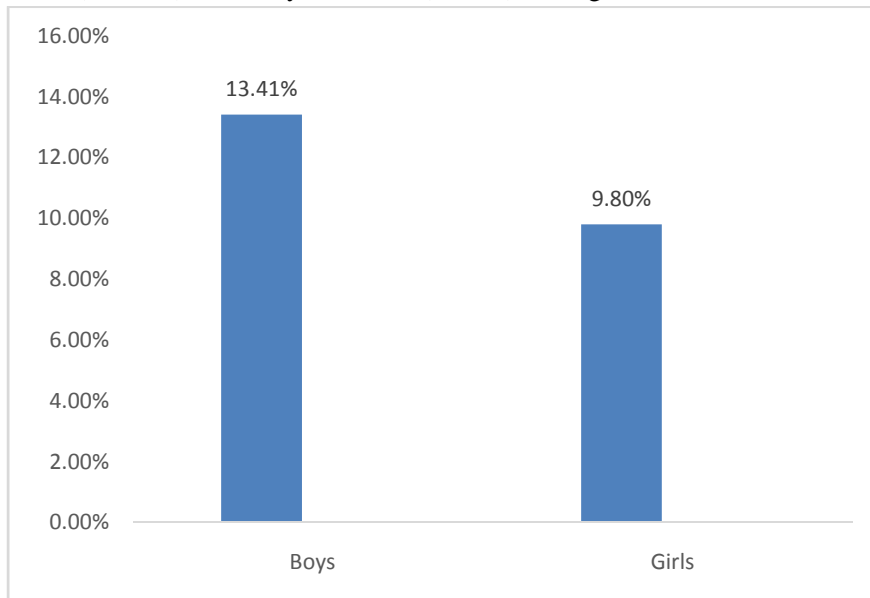
Fluoride level in drinking water in the study area ranged from 0.56 to 2.53 mg/l. In six locations fluoride level in drinking water was more than 1.5 mg/l. Fifteen locations have fluoride level less than 1 mg/l. These locations have maximum number of students affected by dental fluorosis. Four samples have fluoride level in the range of 1 to 1.5 mg/l. Other parts had safe limit of fluoride level.

Other source of drinking water is from bore wells. Twenty five samples of ground water were collected from endemic fluoride areas and tested for fluoride and were found to be within a range of 0.9 to 2.52 mg/l. Fifteen samples had excess of fluoride level (more than 1.5 mg/l). Nine samples had fluoride level in the range 1 to 1.5 mg/l. Only one sample had 0.9 mg/l of fluoride.

Dental fluorosis

Fluoride level in water contributed to dental fluorosis in the study area. It was observed that out of 7857 school children (3777 boys 4080 girls), 1824 (23.21%) were affected by dental fluorosis. It was also noticed that the prevalence and severity of dental fluorosis were found to be more (30-43%) among

the students who were from endemic fluoride area. It was also found that out of 1824 children affected by dental fluorosis 1054 (13.41%) were boys and 770 (9.80%) were girls.



Prevalence of dental fluorosis

Report of Drinking Water Sample

Sl. No	Places	pH	EC (μS/cm)	CO ₃ ²⁻ (mg/l)	HCO ₃ ⁻ (mg/l)	Cl ⁻ (mg/l)	SO ₄ ²⁻ (mg/l)	Ca ²⁺ (mg/l)	Mg ²⁺ (mg/l)	Na ⁺ (mg/l)	K ⁺ (mg/l)	RSC (mg/l)	SAR (mg/l)
1.	NelkattumSeval	7.2	320	9	42.71	42.5	0	28.1	18.2	5.1	1.9	0	4.14
2.	Therkuchatram	7.8	260	6	109.8	21.3	0	32.1	7.3	5.9	1.9	0	5.5
3.	Sangupuram	7.5	210	0	79.3	28.4	0	18	9.7	5.1	1.9	0	5.3
4.	Vasudevanallur	7.4	610	9	250.1	60.3	0	34.1	28	27.6	1.2	95.4	19.5
5.	Vellanaikottai	7.5	780	15	372.2	42.5	0	76.1	18.2	10.8	0.4	74.2	6.7
6.	Thalaivankottai	7	160	0	42.71	31.9	0	16	7.3	3.4	1.2	0	8.28
7.	Paraiyatti	7.5	170	0	54.9	28.4	0	20	4.9	5.5	2.3	0	6.4
8.	Puliangudi	6.8	240	0	42.71	60.3	0	10	20.7	2.9	1.2	0	2.76
9.	Tharukapuram	7	230	0	79.3	35.5	0	16	13.4	7.36	2.3	0	7.4
10.	Emanpatti	7.8	1300	3	360	241.1	9.6	74.1	21.9	135.5	1.9	26.5	72.7
11.	Patcheri	7.5	3660	15	292.8	230.5	49.5	58.1	23.1	170.9	3.9	26.5	110.9
12.	Thumbamedu	7.8	260	6	109.8	21.3	0	32.1	7.3	5.9	1.9	0	5.5
13.	Duraisamiapuram	7.4	920	0	384.4	85.1	23	38.1	18.2	117.8	1.9	153.7	90.4
14.	Panaiyur	7.5	1100	0	268.4	212.8	29.3	56.1	9.7	147.4	3.9	42.4	109.9
15.	Mullikkulam	6.8	140	0	36.61	28.4	0	18	3.6	2.9	1.2	0	3.68
16.	Ramanathapuram	8	240	6	103.7	17.7	0	4	14.6	5.5	23.4	26.5	6.4
17.	Koodalur	7.6	240	0	85.4	35.5	0	24	10.9	5.1	1.9	0	4.8
18.	Thenmalai	7.6	1180	21	457.6	120.6	12.5	60.1	18.2	135.5	1.9	196.1	90.2

19.	Arulachi	7.6	650	6	244	81.6	0	60.1	24.3	14.9	1.2	0	9.4
20.	Desigampatti	8	800	15	183	141.8	23	56.1	19.5	72.4	4.3	0	48.8
21.	Rayagiri	7.6	180	6	61.01	21.3	0	28.1	1.2	4.83	1.9	0	5.5
22.	Sivagiri	7.6	240	6	91.5	24.8	0	24	9.7	5.9	1.9	0	5.9
23.	Saravanapuram	8	660	15	225.7	78	9.6	46.1	20.7	53.8	2.3	10.6	37.9
24.	Visvanathaperi	6.8	2800	3	555.2	609.9	33.1	198.4	34	294.9	1.9	0	117.3
25.	Keelapudur	8	1800	3	61.01	24.8	0	20	6.1	5.52	1.9	0	6.2

Table -2

S.NO	PLACES	Amount of fluoride in mg/l	
		Drinking water	Ground water
1.	NelkattumSeval	0.62	1.33
2.	Therkuchatram	0.63	1.75
3.	Sangupuram	0.65	1.98
4.	Vasudevanallur	1.54	1.67
5.	Vellanaikottai	1.85	1.91
6.	Thalaivankottai	0.63	1.49
7.	Paraipatti	0.59	1.61
8.	Puliangudi	0.56	0.90
9.	Tharukapuram	0.74	1.30
10.	Emanpatti	0.63	1.19
11.	Patcheri	1.45	2.10
12.	Thumbamedu	1.28	1.80
13.	Duraisamiapuram	1.90	1.90
14.	Panaiyur	1.60	1.70
15.	Mullikulam	0.60	1.80
16.	Ramanathapuram	0.59	1.45
17.	Koodalur	0.63	1.60
18.	Thenmalai	2.15	2.20
19.	Arulachi	1.23	1.43
20.	Desigampatti	0.77	1.20
21.	Rayagiri	0.56	1.49
22.	Sivagiri	0.72	1.10
23.	Saravanapuram	0.62	2.46
24.	Vishvanathaperi	1.42	1.52
25.	Keelapudur	2.53	2.52

Discussion

During this work, it was noticed that most of the water quality parameters in drinking water were found to be in accordance with WHO and Indian standards which had no significance on dental fluorosis.

Calcium level in these samples was very low and which might be contributed to increase in number of students affected by dental fluorosis. In six samples fluoride level in drinking water was more than 1.5mg/l. It was also observed that most of the students affected by dental fluorosis were from these endemic fluoride areas. Dental fluorosis among boys was more prevalent than girls in the age group ten to sixteen years^{18,19}. Many studies have proved that there is a direct relation between fluoride in water and dental fluorosis^{20,21}.

The prevalence of dental fluorosis was found to be 23.21%. It is similar to findings in rural primary school children in Chidambaram taluk, Tamilnadu²² and school children in Udaipur, Rajasthan²³. It has also been studied in .It is also in accordance with Alapuzha district, Kerala²⁴. Among the students affected dental fluorosis 13.41% were boys and 9.80% were girls. It showed that boys were mostly affected than girls. It may be due to the fact that boys take drinking water from other sources also.

In the fluorosis affected area it was observed that most of the times they took water from wells and bore wells for drinking and cooking.

Conclusion

This study gave a clear picture regarding fluoride level and dental fluorosis in the various locations of Sivagiri taluk, Tamilnadu India. Sivagiri taluk. Fluoride level in water is due to geological formation. From primary school to higher secondary school children it was noticed that there is decrease in percentage of fluorosis among both boys and girls. This study is useful to get safe drinking water, to conduct awareness programs regarding food and hygienic habits.

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