POLLUTION OF DRINKING WATER DUE TO FLUORIDE AND DENTAL FLUOROSIS AT HUNAGUND TALUK OF BAGALKOT DISTRICT, KARNATAKA

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ABSTRACT: - Ground water quality in Hunagund taluk of Bagalkot district has been studied with special reference to the presence of fluoride. The main purpose is to draw attention to the presence and the severity of dental fluorosis. Out of 3000 people aged 8-50 years 1275 (42.5%) had dental fluorosis of some degree. The well being of humans depends on quality of drinking water. Consumption of water containing excess fluoride over over long period results in fluorosis. Currently, fifteen states of India are endemic for fluorosis. The presence of fluoride in exceeding limits and its related problems of drinking water prevailing in many parts of India is well documented. Fluoride in drinking water is known for both beneficial and detrimental effects on health. Many solutions to these problems were also suggested. Fluoride from water or waste water can be removed by an ion exchange/ adsorption process or by coagulation. Precipitation process. The paper presents the current information on defluoridation.

Key words: Pollution, Drinking water, Dental Fluorosis

INTRODUCTION

Fluorine is the most electronegative element, distributed ubiquitously as fluorides in nature. Water is the major medium of fluoride intake by humans (Environmental Health criteria for fluorine and fluorides, Geneva, WHO, (1984). Fluorosis is a major public health problem resulting from long term consumption of water with high fluoride levels. It is characterized by dental mottling and skeletal manifestations such as crippling deformities, Osteoporosis and Osteosclerosis. In India, as many as 15 states are affected by endemic fluorosis, and an extensive belt of high fluoride in water and soil is reported in south India (Pandit C G et al (1940), Satyanarayana et al (1953), Siddiqui A H et al (1955), Yadawe M S. et al (2010). Gulbarga district of Karnataka was found to be a fluorosis endemic area by Nawlakhe et al (1993) and Susheela A K et al (1999). However a detailed survey for clinical manifestations attributable to fluoride toxicity has not been recorded. Children residing in Kheru Nayak Thanda, a village 35km north of Gulbarga city, exhibited skeletal deformities from the waist downwards. In November 1998, the parents of these children brought them to the district general Hospital, Gulbarga, to be certified as physically handicapped.

Dental fluorosis is one of main epidemic dental disease which affects people where the intake of fluoride exceeds normal levels at the time of tooth formation. A fluoride concentration of 0.5-1.2mg/L is an accepted level in water (Murray J et al, 1997). The severity increases with increase in fluoride intake (Hassan A K (2002), Mitchell L et al (1992), Black G V et al (1916), Goldstein R E et al(1994),WHO (1994), Smith B G N et al, (1995) . This disease occurs due to toxic effects on the ameloblast cells during the formative stage of tooth development leading to defective enamel formation (Cawson et al. (1990), Schafer W G et al, 1974, Eversole L R et al 1992). The disease starts as chalky white spots, which later turn to brown (Cawson et al, (1990), Contra lateral teeth and to a certain extent upper and lower teeth, show similar severity of fluorosis (Thystrap A (1974), Van Palenstein et al (1997) .Drinking water samples were collected and analyzed for Ec, pH, alkalinity, calcium, magnesium, chloride, sulphate, fluoride, total dissolved salts, nitrate, total hardness and iron. This study was carried out to investigate the prevalence of dental fluorosis at Hunagund, where no studies on this problem have been done.

Materials and Methods

Water samples were collected in Pet bottles of liter size and closed tightly. A total of 65 ground water samples were collected. Fluoride contents in all the samples have been determined. However, determinations of other ions and parameters have been carried out using standard methods (APH, 1995).

Fluoride contents were determined by SPADNS out method Dean Adams V et al, (1990).SPADNS (2-(p-Sulpho-Phenylazo)-1, 8-dihydroxy-3, 6-napthalein disulphonate) was obtained from E-Merk and SRL. The Alizarin red-S method was found useful in higher fluoride range while SPADNS reagent was employed in low fluoride range Gupta S C et al, 1993). A survey was made after examination for dental fluorosis of people of both sexes between the ages of 8-50 years at

Hunagund taluka who attended P.M.Nadagouda Dental College Bagalkot from June 2007 to Nov 2009. The permanent teeth were the only ones examined. The examinations were carried out by dentists to standardize the readings. The total number of people examined was 3000. Each person's teeth were carefully examined in natural light Hassan A K, et al 2002, WHO (1977). The results were classified according to age and severity.

Table.1 Jackson Index of dental fluorosis

Class	Criteria
I	White areas < 2mm
II	White areas ≥ 2mm
III	Brown areas < 2mm, irrespective of presence of white areas
IV	Brown areas ≥ 2mm irrespective of presence of white areas
V	Horizontal white lines irrespective of presence of non linear areas

RESULTS AND DISCUSSIONS

The findings of the present investigations are summarized in Table.2 was also made with WHO (1994) drinking water standards.

Table2: Physico-chemical parameters and health impacts of water at Hunagund taluka of Bagalkot district

S.No	Village	Conductivity Mhos/cm	pH	Alkalinity as $CaCO_3$	Calcium mg/L	Mg mg/L	Cl mg/L	SO_4^{-} Mg/L	F mg/L	TDS mg/L	NO_3^{-} mg/L	Total Hardness mg/L	Fe mg/L	Remarks
1	Kudalsangam	1860	8.4	448	124	92	348	40	4.4	1209	20	504	0.1	NP
2	Bisaladinnii	3420	8.43	520	176	135	984	60	4.4	2223	25	732	0.0	NP
3	Choudkamaldinni	1350	8.33	124	38	38	176	05	2.2	878	05	280	0.1	NP
4	Katagur	1640	8.67	516	132	92	240	40	1.5	1066	25	512	0.2	P
5	Kengalkadapatti	8.70	8.23	360	144	55	164	35	0.1	566	15	368	0.00	P
6	Turadagi	5530	8.13	484	324	236	984	120	2.4	3596	40	1296	0.1	NP
7	Valakaldinni	2840	8.23	428	184	268	756	120	3.4	1846	40	1288	0.2	NP
8	Kajagal	1030	7.44	380	120	92	272	40	4.4	670	25	500	0.2	NP
9	Sangam cross	760	8.14	364	104	83	172	35	0.6	494	20	448	0.2	NP
10	Belagal	2080	8.31	272	528	40	576	120	0.4	1358	30	816	0.1	NP
11	Bisanalkoppa	1890	8.35	300	240	48.8	108	102	1.4	1210	28	718	0.1	NP
12	Medinapur	2300	8.40	335	120	234	420	120	3.4	1495	47	1084	0.1	NP
13	Nandanur	1460	8.88	448	152	149	332	60	1.2	949	25	760	0.00	P
14	Varagodadinni	1030	8.36	368	184	125	272	45	4.4	669	25	684	0.1	NP
15	Kirasur	1210	8.12	304	175	110	290	30	0.2	745	18	400	0.1	P
16	Havanur	1300	8.14	344	100	95	280	25	0.00	845	20	408	0.2	P
17	Chittaragi	1670	8.89	604	12	70	176	30	1.5	1083	15	304	0.1	P
18	Gangoor	2720	8.55	472	284	86	612	50	2.0	1768	20	640	0.2	NP
19	Hadalagi	1060	8.93	608	60	25	176	05	1.5	949	05	168	0.1	P
20	Khairwadagi	910	8.30	165	236	68	188	30	0.6	591	15	308	0.2	P
21	Hiremagi	2850	7.9	988	588	150	775	140	0.1	1854	50	1205	0.1	P
22	Bevinal	1860	8.4	940	140	200	840	200	1.8	1380	45	1130	0.2	NP
23	Madapur	1060	8.90	896	72	40	265	0.5	4.8	1274	0.5	240	0.1	NP
24	Budihal inam	1640	8.5	780	225	50	665	100	1.4	1240	40	1020	0.1	NP
25	Kallagonal	1760	8.0	880	500	45	723	150	1.2	850	30	1000	0.1	P
26	Huliganahal	960	8.7	670	545	100	800	200	1.8	1400	50	1230	0.2	NP
27	Ganjal-1	2160	8.59	420	125	65	363	40	5.0	1404	10	384	0.2	NP
28	Ganjal	2200	8.60	922	126	68	768	35	4.8	1369	12	398	0.2	NP
29	Herimalagavi-1	2430	8.4	400	128	80	544	45	4.0	1880	10	450	0.1	NP
30	Herimalagavi-11	2500	8.9	410	126	84	540	48	4.5	1498	10	440	0.1	NP
31	Chikkamalagavi-1	2080	8.5	455	128	49	510	35	4.8	1369	11	398	0.2	NP
32	Bekamaldinni	703	8.33	212	36	10.5	68	25	1.2	475	20	136	0.2	NP
33	Chintakamaldinni	508	7.2	180	40.5	18.6	75	20	1.4	500	25	78	0.2	P
34	Gattiganur	9660	7.90	192	182	225	180	28	3.0	6279	22	1360	0.1	NP
35	Jalakamaldinni	590	8.23	104	16	42	35	40	0.8	384	30	76	0.1	P
36	Kadihal inam	1160	8.12	205	46.40	5.09	96	37	1.4	754	16	136	0.1	P
37	Revadihal	760	8.2	350	109	84	172	30	2.0	440	0.2	65	0.1	P
38	Binjawadagi	4210	7.80	188	38.40	68.25	696	120	0.0	2736	25	892	0.2	NP
39	Hegadal	3420	8.4	440	120	92	300	40	3.5	1200	20	508	0.1	NP
40	Jalakamaldinnii	590	8.25	104	57.60	16.75	41	05	0.8	383	20	76	0.1	P
41	Kadihal inam	1160	8.12	204	46.4	5.09	96	30	1.4	754	05	136	0.1	P
42	Revadihal	760	8.2	350	109	84	172	30	0.8	490	20	440	0.2	P
43	Aiholi	2950	7.55	220	177.6	70.62	656	35	0.00	1917	25	736	0.1	P
44	Hoovinhalli	2800	7.30	235	166.7	65.00	398	40	0.2	1620	30	526	0.1	P
45	Kalligudd	2970	735	320	358.5	67.75	612	20	0.4	1930	10	616	0.2	P
46	Mullur	2390	8.30	852	65	0.97	120	25	0.6	1553	05	156	0.00	P
47	Nimbalgund	2630	7.33	392	54.40	68.23	384	20	0.00	1709	15	416	0.1	P
48	Dhannur	3870	7.90	300	97.60	114.3	900	40	0.0	2515	20	716	0.1	P
49	Iddalagi	3120	7.47	296	52.80	92.15	504	14	0.00	2028	25	512	0.2	P
50	Hullalli	1600	7.6	296	30.30	47.83	136	30	0.4	1040	25	272	0.00	P
51	Kamadatta	3140	7.39	488	83.20	132.2	784	30	1.8	2042	30	752	0.1	P
52	Ametti	4220	8.03	388	38.40	123.0	908	40	1.8	2743	40	604	0.2	NP
53	Papanathanal	3725	7.65	282	46.00	85.00	674	15	1.3	2430	25	528	0.00	P
54	Adihal	3820	7.30	316	195.20	63.25	744	15	0.2	2483	20	748	0.1	P
55	Kamatagi	2020	7.35	504	201.4	6.19	332	40	0.6	1313	25	528	0.1	P
56	Aminagad	1950	8.1	744	35.20	74.90	176	30	0.2	1267	20	1267	0.1	P
57	Koujaganur	2180	7.40	308	112	15.45	220	20	0.3	1417	1417	05	0.1	p
58	Marol	4530	7.95	156	64	23.30	1045	40	2.8	2944	25	256	0.1	NP
59	Anapakatti	2670	8.1	420	67.20	8.86	248	25	3.5	1735	30	204	0.00	NP
60	Havaragi	3140	7.92	416	120	1.94	536	70	1.6	2042	20	308	0.2	NP
61	Sulibhavi	930	7.80	252	84.80	31.93	84	30	1.2	604	05	344	0.1	P

In the present study electrical conductivity values of the samples were found to be 590 to 5530 mhos/cm. It shows that most of the samples were within the permissible limits (7.50-20.00mhos/cm). The pH value ranges from 7.30 to 8.93 and it is found to be well within the permissible limits prescribed for drinking water standards 6.5 to 8.5 WHO 1970, while some samples exceed the permissible limit. Alkalinity of water is a measure of its capacity to neutralize acids. The alkalinity might be due to high pH. The alkalinity values provide guidance in applying proper doses of chemicals in water and waste water processes particularly in coagulations, softening and operational control of anaerobic digestion. The values of alkalinity ranged from104 to 852mg/L.

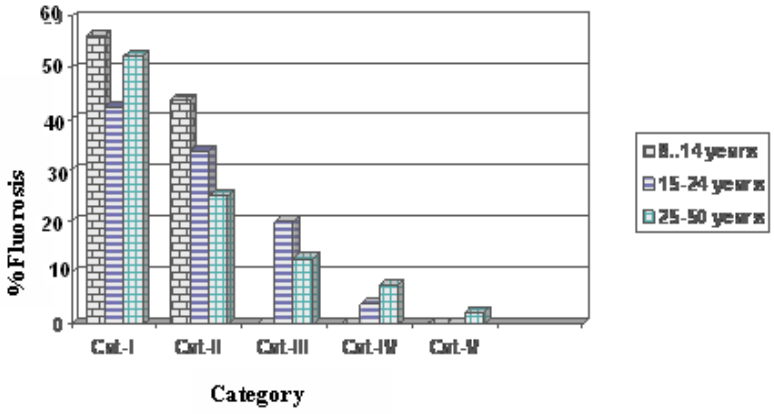
Calcium is essential for organisms, being an important cell wall constituent and regulates various physiological functions in animal too. The calcium values ranged from 30.3 to 488mg/L. In most of the fresh water total hardness is imparted mainly by the calcium and magnesium ions, which apart from sulphate, chloride and nitrates found in combination with carbonates and bicarbonates. In the present study some of the samples exceed the permissible limit of 75mg/L. Magnesium ranged from 30.3 to 268mg/l. Some samples exceed the permissible limit of 30mg/L. Chloride contents varied from 41 to 1045mg/L indicates the pollution status of the water body. Chloride ions bear significant correlation with pH, mg and Na. The sulphate is the indicator of hydrogeology and solution of fertilizer into water. During the study sulphate ranged from 0.5 to 120mg/L which is within the permissible limits of WHO. It is evident from the analysis data; it is obvious that the fluoride concentration is more than the limits for drinking purpose. Fluoride content of 1mg/L in drinking water has no biological side effects (Galagon D T et al 1953). Studies in this area revealed that fluoride level is more than the permissible limit in the drinking water and consumed for a period of 5-10 years caused dental fluorosis. Between 4-8mg/L for a period of 15-20 years caused form of dental and skeletal fluorosis. Therefore, drinking water is sufficient to produce severe form of dental and mild form of skeletal fluorosis consumed for a period of 15-20 years (Pendry D G et al). Health status of the people is varied in different villages because of severity of fluorosis, which is direct reflection of fluoride content of drinking water.

TDS is an indicator of overall water quality, mineralization and used for comparison of water quality overtime. TDS was ranged from 383 to 3596mg/l, where in many samples were above the permissible limit of 500mg/L. Nitrate values ranged between 0.2 to 50mg/L which are within the permissible limit. The total hardness is the indicator of hydrogeology aesthetic quality of water. During the study, hardness was ranged from 5 to 1296mg/L. These findings suggest that the water body is moderately hard. In most of the samples, the iron contents were much bellow the guideline value of WHO i.e out of 61 samples 32 samples were potable while 29 samples were non-potable. Keeping in view the unusual high concentration of the harmful ions vizz fluoride, nitrate, etc it has advisible to test the possibility of ground water of Hungund taluka before using it for drinking. Clinical Symptoms of dental fluorosis at Hungund taluka of Bagalkot District:

The Table-3 demonstrates the incidence and class of fluorosis in each age group and clearly shows the prevalence of more advanced fluorosis in the older age group. The results show the older that 1275 persons (42.5%) of the 3000 examined had dental fluorosis at different stages. Class II and Class-III fluorosis has more common in the 15-25 and 25-50 age groups while class-I was more frequent in ht 8-15 age group.

Table-3. Dental fluorosis in 3000 patients in Hunagund taluka according to Jackson index.

Age Year	No. of patients examined	No of patients with fluorosis	% patients with fluorosis	Class I		Class-II		Class-III		Class-IV		Class-V	
				No.	%	No.	%	No.	%	No.	%	No.	%
8-14	500	160	32.00	90	56.25	70	43.75	-	-	-	-	-	-
15-24	1300	545	41.92	230	42.20	184	33.76	109	20.00	22	4.03	-	-
25-50	1200	570	47.50	298	52.28	143	25.08	73	12.80	43	7.54	13	2.28
Total	3000	1275	42.50	618	48.47	397	31.13	182	14.27	65	5.09	13	1.01



These results can be explained by the cumulative effects of fluoride in the body and on teeth. The teeth of older patients are exposed to the effects of fluoride for longer than those of younger people. Consequently, they will establish the secondary features of fluorosis (Thystrap et al, APHA 1995, Geneva, World Health Organisation; 1992 Alberts H F et al 1999, Thyistrup A, et al (1978), Jackson R D et al, (1995). Hence class V fluorosis was found only in older patients (25-50).

The findings of this study are in accordance with those of studies which have been done on the prevalence of dental fluorosis in other parts of the world (Oral health survey basic methods, 1997) . No research has yet been done in the Hunagund taluka, so this study draws attention to the existence of problem in this area. Morever, this is the first study which has been done to examine the extent of the condition in Hunagund taluka.

Conclusion

From the present study, it can be concluded that people of Hunagund taluka consuming water more than 1.5 ppm of fluoride are suffering from dental and skeletal fluorosis. Major symptoms of dental fluorosis included lack of luster, browning, pain, pus and untimely loss of teeth. There is an urgent need to impose preventive measures in these villages in the form of supply of safe drinking water and / or defluoridation of available water.

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