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Periodic Research

Socio- Economic Losses to Human Health in Mandla District, (M. P.) Due to High Fluoride Bearing Ground Waters and Its Mitigation

Abstract

The menace of high fluoride concentration in ground water resources has now become one of the major health related geoenvironmental issues in many countries of the world. India is also confronting the same problem, where the high fluoride concentration in ground water resources and the resultant disease "fluorosis" is widely distributed in nearly 150 districts of 15 states. In Madhya Pradesh during recent year the problem of fluoride has reached an alarming proportion, because in discriminate exploitation of water sources and the total lack of awareness of the importance of water quality Human consumption. In our present study in village of Mandla district the problem of fluoride has socio-economic implications as well therefore, immense and immediate efforts are required for isolated secluded and unapproachable population affected with fluorosis. Without any delay by providing sustainable and economically viable defluoridation means Public awareness, and health education is also required for the management of the problem. Our proposed investigation expected to contribute significantly in the field of fluoride toxicity. It is revealed the toxic effects of fluorosis on human body.

Keyword: Fluorosis,Mitigation

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Introduction

Water is a natural transport media of many minerals essential for the very existence of human being, Some ions dissolved in water are essential for human beings if present in appropiate concentration , while higher concentration of same can cause adverse effect to human health. If the concentration of fluoride exceeds 1.5 mg/l, it may causes teeth mottling and still higher concentration may lead to skeletal fluorosis. Monitoring of water quality through National Hydrograph stations of central Ground Water Board, since 1976, shows that fluoride concentration in the shallow ground water of Madhya Pradesh is generally, below 1mg/l and water is safe for potable use. However, fluoride concentration in excess of 1.5mg/l was found in isolated pockets of about 10 districts of State. Nearly 1754 villages or towns in the 10 districts namely Shivpuri, jhabua, Chhindwara, Mandla, Dindori, Dhar, Vidisha, Seoni, Raisen and Sehore have been found partly or fully affected by the problem of high fluoride in the ground water. In addition to these disricts, Ujjain, Neemach, Mandsour and Gwalior have also been ,identified where few villages recorded fluoride in the ground water in excess of 1.5mg/l. In Madhya Pradesh the main sourcess of fluoride in ground water is fluorapatite in area covered by granite and granite gneisses.

In India, Schrott et al (1937) [1] first investigated the occurrence of high fluoride in ground water in Nellore district of Andhara Pradesh, where several people were suffering from endemic fluorosis. Higher concentration , between 1.5to 2.0mg/l fluoride, cause dental mottling. Still higher concentration may result osteosclerosis. (8ppm fluoride), thyroid changes (50ppm) growth retardation (100ppm) kidney changes (125ppm)while 20-80ppm/day of fluoride may cripple human and further may proved fatal (Romani & Goel 2001).

The meance of high fluoride concentration in ground water resources has new become one of the major health related geo-environmental issue in many countries of world. India is also confronting the same problem, where the high fluoride concentration in ground water resources and the resultant disease "fluorosis" is wildly distributed in nearly 150 districts of 15 states.

In Madhya Pradesh during recent years, the problem of fluoride has reached an alarming proportion, because indiscriminate exploitation of

water sources and the total lack of awareness of water quality for human consumption. In our present study the extent of severity of problem was observed in villages of mandla district. The problem of fluoride has socio- economic implications as well, therfore immense and immediate efforts are required for isolated and unapproachable population affected with fluorosis. Without any delay by providing sustainable and economically variable defluoridation means public awareness and health education is also required for the management of the problem. The range of fluoride content variety of spices and other items collected from Lucknow (U.P.) analysed by R. S. Nanda (1972), Rajan et al (1987-1988) studies shown that the absorption of fluoride within minutes after brusing the teeth with fluoridated tooth paste.

The sample of forteen villages from Liliya and lathi Talukas of Amreli District in Gujrat have shown the incidence of dental fluorosis. The incidence of dental fluorosis is given in fourteen villeges ranged from 9.6% to 47-57% and skeletal fluorosis was 1% to 95.9%. An study has been conducted by Venkateswar and Mahajan(1991) and result publised, which focused to used on the fluoride content of crops and other items grown or available in Aanantpur district, Andhra Prades. It has been observed by Susheela et al (1985) that among industrial workers exposed to fluoride pollution in Aluminium smelters, the number of echinocytes are increased depending upon the duration of exposure to the fluoride polluted environment. Besides dental and skeletal fluorosis other symptons like auto abdominal pain, diarrhoea, constipation, blood in stools, blotted feelings (gas), tenderness in stomach, feeling of nausea and loss of appetite are common complaints due to fluoride toxicity. The stomach and intestinal linining (mucosa) is destroyed with loss of microvilli, drying up and cracking of the cell surface and mucus production is hampered (Susheela et al 1992). The study of Gupta et al (1996) graded twenty five children from Jaipur, Rajisthan for dental clinical and skeletal fluorosis before and after treatment with calcium and vitamin C.

Fluoride content in drinking water of a few villages in shivpuri and jhabua districts ranged in between 1.5 to 4.2 ppm. Chakma et al (1996) reported that in Tilaipani village of mandla district, Madhya Pradesh, Genuvalgum or Knock Knee was 51.1% among children below 20 years . While dental mottling was 74.4% among children of same age group in Hirapur, Knock knee was 6.25% among the children of the same age group.

Fluoride when consumed or inhaled in excess , can cause several health problems. Excess quantity of fluoride affects mainly the teeth and skeleton of human body. Our proposed investigations is expected to contribute significantly in the field of fluoride toxcity. The work is relevant to the present day problems and need of the affected society in particular and the country in general due to its application in the field of Environmental pollution. It will revealed the toxic effects of fluorosis and socio-economic losses to human health.

Material and Method

Study Design- The three villages were selected for the Dental and skeleton fluorosis which are situated about 15 to 20 km. from the Mandla town. The villages are Tilaipani, Padripatpara and Barbaspur included Mandla city.

Drinking Water Qualilty

Analysis was carried out focusing on fluoride in water. For fluoride testing Ion elective electrode technology was adopted.

Dental Fluorosis – The 25 children were selected from the primary and middle schools of study villages. The criteria for manifestations of dental fluorosis and skeletal fluorosis were used as follows-

Dental Fluorosis Grade

Grade 0-Normal, translucent, smooth, glossy teeth
Grade I- White Opacities, faint & yellow line.
Grade II- Changes as in grade I with brown stains.
Grade III- Brown line, Pitting and Chipped of edges.
Grade IV- Brown black and loss of teeth. **Skeletal Clinical Grading**
Grade I- Mild - Generalized bone and joint pain.
Grade II-Moderate - Generalized bone and joint pain, stiffness and rigidity, resticted movements of the spine and joints.
Grade III- Severe- symptoms of moderates grading with deformatics of spine and limbs, knock-knees, crippled or bed ridden state.

SOCIO-ECONOMIC EFFECTS - The cases of Tilaipani villages were specially observed for socio-economic losses of human health.

Result and Discussion -

The drinking water quality was carried out focussing on fluoride concentration in water. It is observed in three villages that drinking water sources are mainly hand pumps. It was noted that one of the source of tilaipani village contained 11 ppm fluoride in hand pump, which is maximum limits. But in some other water sources, fluoride level is very low, which are permissible limit of fluoride in drinking water. Some hand pumps dismantled by PHE department, because of high fluoride, but due to loss of awareness and illiteracy, villagers opens the hand pumps and use it. In barbaspur village, the fluoride concentration in one of the source was 8.8 ppm. In the padripatpara village, which is situated near Tilaipani village, the fluoride content was maximum i.e. 8.8f. So ppm the range of fluoride concentration is high in Tilaipani in comparison to other two villages. The municipal corporation started “Nul Jal Yojna” in village padripatpara and barbaspur, but water supply is not proper due to absence of electricity. In Mandla and surrounding areas the mostly contaminated sources (>1.5 ppm fluoride) should be closed by PHE Department (Table). It has been noted that due to illiteracy and lack of awareness, in spite of warning in the hand pumps failed. The villagers were using the hand pumps Sometimes they does not found safe water for drinking etc. In Mandla proper, we could not found any case related to fluorosis, because of awareness. It is suggested that the local administration may be told to replace the contaminated hand pumps with new open wells and

encourage rainwater harvesting and implemented alternate source of safe drinking water in areas. (Table).

Dental Fiuorosis

In our present study grading of dental fluorosis is ranged from I to IV Grades. The percentage of grades were found in our study i.e. grade I is 28% grade II it is 44%, Grade III is 8% and Grade IV is 20% According to study of Gupta et al (1994) shown the same grade of dental fluorosis. i.e. grade '0' (Zero) is 4%, Grade I is 32%, Grade II is 20% Grade III is 2% and Grade IV is 32% in Jaipur, Rajasthan Dislt. This is in agreement with the present study. The study of Edwin Chandra sekaran et al (1989) noticed that the even through the fluoride content in kankpura (Karnatak) was 0.5 ppm which is less than the international safety limit, the total 34 of the examined children had fluorosis. Nanda et al (1974) who reported the occurrence of dental fluorosis in Lucknow, which had an average fluroride content of 0.6 ppm. Some other factors could be responsible for the occurrence of dental flurosis in low fluoride area. Nutritional deficiencies particularly vitamin C and calcium are cited as causes for high fluorois prevalence in low fluoride areas (Pandit and Rao (1940), Reddy and srikant (1971)

Skeletal Fiuorosis

In our study the clinical grade of skelatal fluorosis shown grade III, which is genuvalgum or knock-knee. The maximum sufferers are children below 15 years, belongs to village Tilaipani, less number of cases were found in other two villages. The caste of all the children belongs to mainly scheduled Tribes, Scheduled caste and other backward classes. when compared the skeletal fluorosis of three states Rajasthan, Tamilnadu and Madhya Pradesh, it was noted that there was no cases of genuvalgum repoted from Tamilnadu & Rajisthan but in 14.5% of children below 20 years in Madhya Pradesh show genuvalgum.(Chakma et al 1996), choubisa et al 1997, Karthikeyan et al (1996). Investigation revealed that in Tilaipani, study area Genuvalgum or knock-knee was 51.1% among children below 20years. Once the skeketal fluorosis ,has set in there is no available cure. Rehabilitation of crippling skeletal fluorosis, Patients requires expensive joint bone surgery. Prevention is only effective remedy.It is recommended that people should be directed to safe drinking water. In most areas safe and unsafe sources of drinking water co-exist. Water from safe sources can be used for cooking and drinking purposes. For washing, bathing and domestic use, one can use the water from unsafe sources.

Extent of Problem, Nutritional Status And Socio - Economic Losses

The concentration of fluoride below 1 mg./l is considered for the dental health of children under 10 years of age. It prevent dental carries, but now researches have shown that fluoride is not effective in reducing tooth decay. Decay is related to the educational and economic level of parents. The International Academy of oral Medicine and Toxicology classified fluoride as an up approved medicament due to its high toxicity. (Oza, & Mathur 2001).

Nutritional Status

Fluoride content is high in tea.The consumption of sorghum and jowar help in retention of fluoride (Duckworth and Duckhworth (1978) but the prevalence of fluoride in Tilaipani, PadriPatpara and Barbaspur could not be attributed the latter factors because the food of this region is not sorghum or Jowar but rice and pulses and the main drink of people is tea. The former factor of nutritional deficiency none of locally grown food stuffs were found to contain high fluoride around Mandla. Some habit forming substaces i.e. Gutkha, Gudakku and snuff, sold in local market and consumed by villagers, do not contain high fluoride and their absorption in the body seems to be negligible. It seems that it is only the water fluoride which is responsible for the fluorosis in the area complicated by multiple nutritional deficiencies.

Socio - Economic Losses

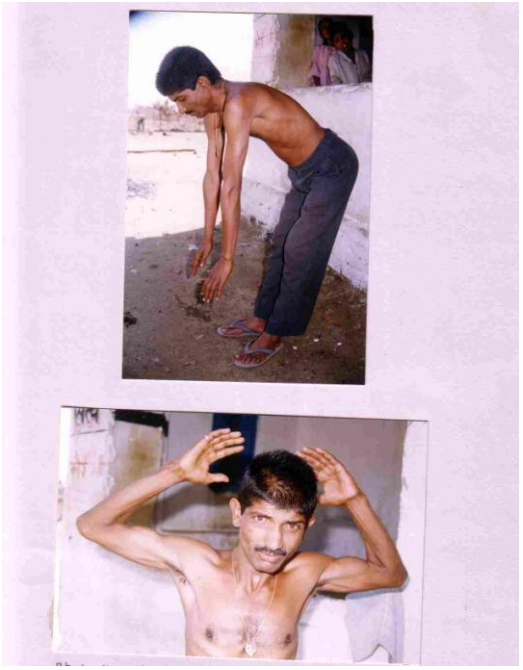
Higher prevalence of dental and skeletal fluorosis in endemic areas shows hyperendemicity of chronic fluoride intoxication in majority of district of Madhya Pradesh. The problem of fluoride has socio-economic implication as well. There are some villages in Madhya Pradesh where no marriages have taken place. In the last several years on people from non-fluorotic areas or villages are not ready to give their daughters to the grooms of endemic villages. In some cases wives have deserted their husbands, left the villages and remarried elsewhere as they could not cope with problematic water.

In males, comparatively higher prevalence of skeletal fluorosis have been observed, since they are basically laboures and farmers and hence consume more water. Their dietary status are also low and also the low intake of vitamin C further aggravate the problem Women coming from non-endemic areas to there afflicated villages after marriage, reflect on low present prevalence in females. Higher prevalences of fluorosis in higher age groups, is due to long exposures to fluorides. Generally skeletal fluorosis in villagers causing directly affecting the economy of villagers, health problems of man and their domestic animals. Which are also basic income sources for them. Consequenly the affected families are facing acute financial crises. Similarly the dental fluorosis not only causes decay of teeth but also adversely affect matrimonial aspect of individual which is also a great social problem.

Special Cases Study of Village Tilaipani

1. **Case Study** -I A typical case of adult male Age 39 years belong to Tilaipani village, shows the high degree of fluorosis, which proved that people have been of fluorosis, people have been consuming water containing high level of fluoride since long i.e. from 1995. He cannot touch the toe of his feet and can not stretch the hand on his back because his muscles and joints movements are decreased due to fluorosis (Photo). It was noted from our study that the high fluoride

content is found in water of Tilaipani village i.e. 11 ppm. (Fig.1- a.b.)



2. **Case Study** – II One of the male child Balram Yadav, age 18 years belong to Tilaipani village, is affected by skeletal and dental fluorosis, migrated to Mandla city from Tilaipani village further study and employment (Photo). (Fig.2- a.b.)

3. **Case Study** - III One of the female child age 11 years showing brown streaks on the teeth because of the fluorsis. The concentration is above 1.5 mg/l. It gives permanent teeth a mottled brown stain colouration to the children (Photo). (Fig.3- a.b.)

HOW TO MITIGATE THE PROBLEM-

1. Inoculation of awareness among rural population regarding cause of the disease.
2. Popularising simple and handy defluoridation techniques at domestic and community level in endemic areas.
3. Using villagers to use water from safe water sources specially for lactating mothers.
4. Blending high fluoride and low fluoride water.
5. Construetion of wells/tubewells in low fluoride area.
6. Adequate use of vitamin C and calcium in diet.
7. Prohibition on use of fluoride rich edibles, cosmetic and luxury items.
8. Promulgation of Aquifer Protection Policy(APP) to avoid over exploitation of ground water to alleviate in gress of fluoride.
9. Involvement of NGO"s" for implementation of domestic defluoridation programme in endemic areas and awareness activities.
10. Use of fluoride ridden toothpaste, tooth powder mouth wash, vitamin supplements etc.
11. Dental fluorosis can be vanished by capping,bleeching or laminated veneering of teeth.

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Tabel 1
Distribution of fluoride level in study areas.

S. No	Name of Village	No.of Drinking warer sources	No. of souses with high fluoride	Fluoride in ppm range	No. of Hand pump dismantle by PHED
1	Tilaipani	14	7	0.140 to 11 ppm	05
2	Padripa tpara	10	3	0.173 to 8.8 ppm	02
3	Barbaspur	5	2	BDL to 8.8 ppm	02
4	Mandla	19	3	BDL to 18 ppm	Nil

Table 2
Details of Dental and Skeleton grades of fluorosis case study

S. No.	Name of Patient	Father's Nam	Sex	Age in year	Grades of Dental	Grade of Clinical Skeletal Tilaipani
1.	Pawan Kuma	Mohan Lal	M	8	IV	III
2.	Ku. Mamta	Makhan Lal	F	11	II	-
3.	Pratap Yadav	Late Hari Prasad	M	13	II	III
4.	Vineeta	Ramkishan	F	9	II	III
5.	Chandan Lal	Pitam Lal	M	14	II	III
6.	Anat Kuamr	Makhan Lal	M	8	I	III
7.	Rajesh kuma	Hari Lal Yadav	M	13	II	-
8.	Ku. Vineeta	Sampat Lal	F	9	IV	-
9.	Deepak Kuma	Krishan Kumar	M	11	I	-
10.	Neeraj Kuam	Khushi Ram	M	13	II	(Padripatpra III
11.	Ku. Suneeta	Shambhu Lal	F	14	IV	-
12	Hare Singh	Shiv Prasad	M	12	IV	-
13	Sunil	Shambu Lal	M	15	II	-
14.	Bhuvan Lal	Arjun Singh	M	15	I	III
15.	Prahlad Kuma	Rajendra Singh	M	11	II	-
16.	Ku. Malti	Chhunnu Choudhari	F	13	IV	-
17.	Kamlesh Kumar	Rammu Lal Choudhari	M	12	I	(Barbaspur) -
18.	Dhaniram	Sahdev Singh	M	11	II	
19.	Ku. Mamta	Chandan Singh	F	10	II	-
20	Siya Ram	Munna Lal	M	6	I	III
21	Savitri Bai	Mahu Lal	F	9	II	-
22	Sunita Bai	Mahu Singh	F	10	III	-
23	Ayodhya Bai	Dimaak Das	M	11	III	-
	Ganga Bai	Dharam Singl	F	8	I	III
25	Ananta Bai	Chandan Singh	F	9	I	-
M-Male F- Female						

Table 3
Demographic characteristics of study villages i.e. Dental Fluorosis

Total No. of Dental Fluorosis Study Group		Age Group in years age range (8-15)		
Male	Female	Age	Male	Female
15	10	8	2	1
		9	-	4
		10	-	2
		11	4	1
		12	3	-
		13	3	1
		14	1	1
		15	2	-

Table 4
Percentage distribution of grades of dental fluorosis (25 cases)

Gupta et al (1994)

S. No	Grades of Dental Fluorosis	Total number of Dental Fluorosis case	% of Dental Fluorosis	No. of grading	% of gradin
1.	0	Nil	Nil	1	4%
2.	I	7	28%	8	32%
3.	II	11	44%	5	20%
4.	III	2	8%	3	12%
5.	IV	5	20%	8	32%

Table 5
Demographic characteristics of study village i.e. skeletal fluorosis (Total 9 cases)

Total No. of skeletal fluorosis study group		Age group in years age range (6-15)		
Male	Female	Age	Male	Female
7	2	6	1	-
		7	-	-
		8	2	1
		9	-	1
		10	-	-
		11	-	-
		12	-	-
		13	2	-
		14	1	-
		15	1	-

Table6
Percentage (%) distribution of skeletal fluorosis in three villages.

Total study case	Skeletal Fluorosis Cases	Name of village	Total No. of Cases	% of skeletal fluorosis
25	9	Tilaipani	5	56%
		Padripatpara	2	22%
		Barbaspur	2	22%

Tabel 7
Demographic characteristics of study area i.e. skeletal fluorosis (Total 9 cases.)

Total number of skeletal fluorosis study group		Age Group in year (6 –15)		
Male	Female	Age	Male	Female
7	2	6	1	-
		7	-	-
		8	2	1
		9	-	1
		10	-	-
		11	-	-
		12	-	-
		13	2	-
		14	1	-
		15	1	-

Table 8
Percentage distribution of skeletal fluorosis in three study area.

Total study case	Skeletal Fluorosis clinical cades	Name of study aresa	Total on of cases	% of skeletal fluorosis
25	9 (36%)	Tilapani	5	56%
		Padripatpara	2	22%
		Barbaspur	2	22%

Table 9
Village wise distribution of fluoride Contaminated drinking water in relation to percent prevalence of dental and skeletal fluorosis -

S.No.	Name of Villages	No of drinking water sources with high fluoride	% Prevalence village		
			Dental	Genuval gun	sleletal
1	Tilaipani (n-441)	05	21.76	20.60	18.59
2	Barbaspur (n-528)	02	16.28	5.30	13.49
3	Simariya	01	0.79	2.37	5.43
4	Padripatpar a (n-358	02	8.33	6.70	14.58
5	Mandla	03	-	-	-

(Chakma et al)

Table 10
Skeletal fluorosis in relation to age and sex

	Age Years	Male examined	S.F.+ ve	Examined	Females sf+ve
1	21-30	513	56 (10.9)	450	36(8)
2	31-40	452	27(27.6)	406	75 (18.7)
3	41-56	256	123 (49.2)	250	83 (33.2)
4	51-60	345	203 (58.8)	280	142 (50.7)
5	>60	120	76 (63.8)	100	62 (62)

(Ozha, DD and Mathur S.P. 2001)

.		Madhya pradesh *				Rajasthan **				Tamilnadu ***			
1	Main Source of Fluoride	Deep bore well water depth-29 to 41 meter 0- 10.83 PPM				Bore well water Depth - not known 0.8 to 10 PPM				Bore well water Depth - not known 0.3 to 8 PPM			
2	Level of Fluoride	Childre n <20 yrs		Adults >20 yrs		Children <16 yrs		Adults >16 yrs		Children <16 yrs		Adults >16 yrs	
		No. SURV.	%	No. SURV.	%	No. SURV	%	No. SURV.	%	No. SURV	%	No. SURV	%
3	Dental Fluorosis	1147	21.2	1116	0.7	1224	62.7	1364	69.7	621	59.2	467	65.2
4	Skeletal Fluorosis	1147	5.7	1116	21.4	545	27.8	545	27.8	621	0.0	467	11.3
5	Genuvalgum	1147	14.5	1116	1.04	545	0.0	545	0.0	621	0.0	467	0.0

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