

**An Epidemiological study on  
FLUOROSIS  
in  
Amatikra village of Podi Uroda  
in Korba District, Chhattisgarh**

**By**

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## **Summary Note**

This is a report of the investigation of the problem of fluorosis in Aamatikra village done in May 2012. In response to the identification of two patients of skeletal fluorosis from the same village, Jan Swasthya Sahyog conducted an epidemiological study that included testing the urinary fluoride levels of affected people and analysis of fluoride content of all drinking water sources. We reviewed the literature for the extent of this problem in the region too. Once we confirmed that indeed fluorosis is a major public health problem in this area, we have suggested remedial measures for implementation by the community including the PRI as well as the government.

## Background

Fluorine is the 13th most abundant element available only in the earth crust. As the ground water passes through the fluoride rich rocks it carries fluoride with it, hence most of the fluoride is found in ground water than surface water.

Fluoride has been shown to cause significant effect on human health through drinking water. Different forms of fluoride exposure are of importance and have shown to affect its body content and thus increasing risk of fluoride prone disease. It has a beneficial effect on teeth by preventing and reducing the risk of tooth decay. In fact, concentrations lower than 0.5mg/L intensify risk of tooth decay. However, higher concentration (more than 1.5 – 2mg/L) fluoride becomes quite detrimental to health. Excessive ingestion causes dental fluorosis as well as skeletal fluorosis and osteoporosis as a result.

WHO and IS 10500 (1991) standards permit only **1.5 mg/L and 1.0 mg/L** respectively as a safe limit for human consumption. Unfortunately, people in many areas in the country have to consume water with high fluoride concentrations, e.g. in several districts of Rajasthan, India fluoride levels **of up to 24 - 44 mg/L**

## Types of Fluorosis

- 1) Dental Fluorosis - is a developmental disturbance of dental enamel caused by excessive exposure to high concentrations of fluoride during tooth development. The risk of fluoride overexposure occurs between the ages of 3 months and 8 years of age. In its mild forms (which are its most common), fluorosis often appears as unnoticeable, tiny white streaks or specks in the enamel of the tooth. In its most severe form tooth appearance is marred by discoloration or brown markings. The enamel may be pitted, rough and hard to clean. The spots and stains left by fluorosis are permanent and may darken over time. Cosmetically they are very disabling, making many to comment that it seems that 'these children never brush their teeth'



- 2) Skeletal Fluorosis - is a bone disease caused by excessive consumption of fluoride. In advanced cases, skeletal fluorosis causes pain and damage to bones and joints, which may go on to cause severe disability and handicap. Thus it can become a serious public health problem
- 3) Non – Skeletal Fluorosis – it affects soft tissue in the body such as muscle, the blood vessels, the stomach lining, testicles and ovaries. Causing several organ specific problems

#### **Hand pump as a water source –**

In non-industrial areas, since excessive fluoride enters drinking water only if it is ground water, the hand pump became the first tool that can get fluoride in excessive doses for people.

**Hand pumps** are manually operated water pumps which use human power and mechanical advantage to draw water from depth.

In 1969, Cyrus Gaikwad working with the 'WAR ON WANT' project, Church of Scotland Mission at Jalna, Maharashtra designed a new pump. It was alternative to the cast –iron 'family' pump. But to meet community need, community hand pump were dug which was made of steel. Another voluntary agency, the American Marathi mission project at Vadala, Maharashtra produced improve version of Jalna. It was more accurately fabricated. But at Coimbtore Water Development Project, it underwent more modification. In 1970s Sholapur well services came up with better pivot design for hand pumps.

Today the hand pumps are widely used as a source of potable water. It is the cheapest way to make the water available for household use in all seasons. The depth of hand pump depends on the level of ground water. Many a times this depth becomes an important determinant for presence of minerals and salts in water. Water drawn from shallow hand pumps is likely to contain less minerals and salts than deeper hand pumps and reduces the risk of diseases caused due to high levels of minerals and salts in the body. Generally, the hand pumps deeper than 250 ft. may have high levels of dissolved salts and minerals. So it becomes very important to examine at least the potable water source for mineral contents and avoid the high levels of it which in a due course of time has various ill effects on the body.

### **Rationale for study**

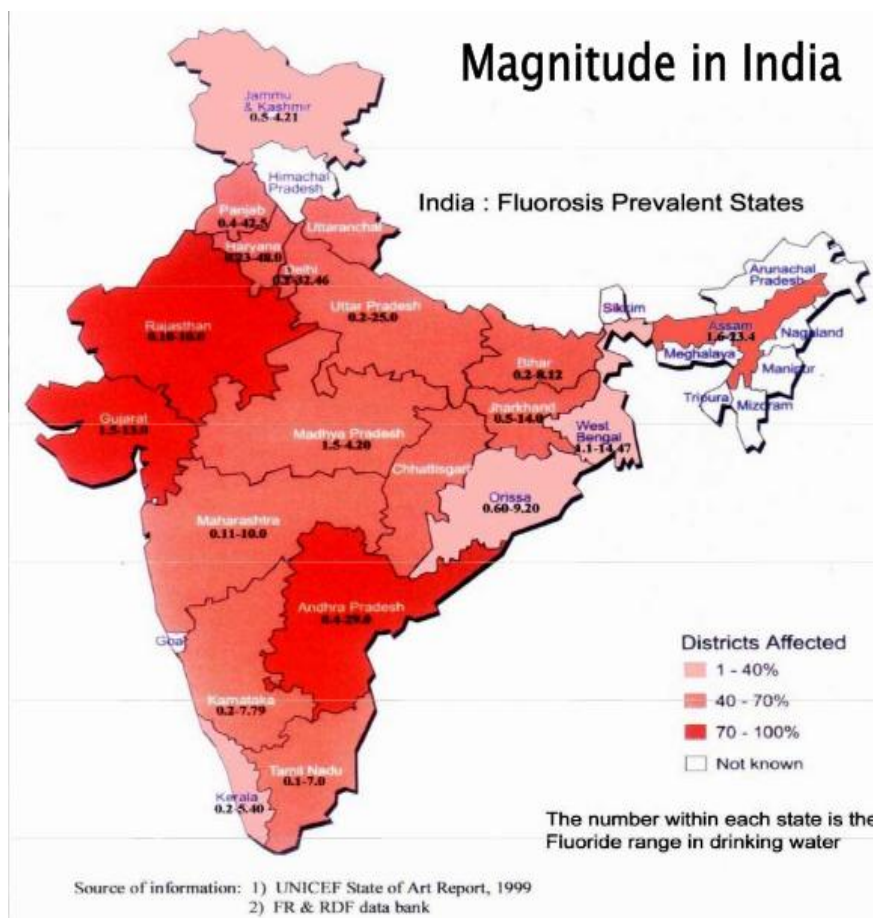
On 23 April 2012, two brothers, Shree Vedprasad and Shree Bhola sikh from Aamatikra village came to JSS for treatment of severe back pain, inability to walk straight and inability to work well which they had been suffering from for past 3 years. Clinical and Radiological examination revealed that both were suffering with skeletal fluorosis especially noticed in the spine (see chest X rays) Additionally, Shree. Bhola sikh also had pulmonary tuberculosis and premature senile cataract too. We learnt from them that there are many people in their village who are suffering with similar kind of problem and large number of young children with discoloured teeth. On the request of the two patients, we decided to conduct an investigation into the problem for fluorosis in that village. That would include collecting water sample from all water bodies and urine samples to see the gravity of problem. On 17<sup>th</sup> May 2012, a team of physician, nurses, social workers and laboratory assistants went to Aamatikra village where they collected household information, examined affected adult and all children, took water body and urine samples from few villagers and conducted village meetings.

## Epidemiology

Fluoride in water is mostly of geological origin. Waters with high levels of fluoride content are mostly found at the foot of high mountains and in areas where the sea has made geological deposits. Known fluoride belts on land include: one that stretches from Syria through Jordan, Egypt, Libya, Algeria, Sudan and Kenya, and another that stretches from Turkey through Iraq, Iran, Afghanistan, India, northern Thailand and China. There are similar belts in the Americas and Japan. In these areas fluorosis has been reported.

## Fluorosis in India

Rajasthan and Gujarat in North India and Andhra in South India are worst affected. Punjab, Haryana, Madhya Pradesh and Maharashtra are moderately affected. Tamilnadu, West Bengal, Uttar Pradesh, Bihar and Assam are mildly affected. Throughout India fluorosis is essentially Hydrofluorosis except in parts of Gujarat and U.P. where industrial fluorosis is also seen.



## References from other studies

Few researches have been carried out in fluorosis affected area in India to see the gravity of problem and reason behind it.

Study conducted by Choubisa 2001 in southern Rajasthan, India showed that both children and adults were suffering with dental fluorosis at 1.5 ppm fluoride level. The maximum prevalence of dental fluorosis (77.1%) was found in the 17 -22 year age group. Only adults were suffering with skeletal fluorosis at 1.5 ppm fluoride level. The prevalence of skeletal fluorosis was higher in males and it increased with age and higher fluoride level. Deformities such as crippling, kyphosis and genu varum were observed most frequently in higher age group (> 40 yrs) at a fluoride concentration of 2.8 ppm or higher.

A study conducted at Tamil Nadu by Murugan A. et al 2011 findings revealed that the percentage prevalence of fluorosis in the study population was 17.1%. The study explained the age and sex specific incidences of dental fluorosis. In males it was 21.42% and in females 19.98%. It was also noted the inhibitory role of fluoride on various blood components. 'B' and 'O' blood group individuals were found more vulnerable to water fluoride intoxication than 'A' and 'AB' blood group people.

Another study conducted at North – West district of Tamil Nadu by Harikumar et al 2007 noted that 126 water samples were content more than WHO cut off level of 1.5ppm fluoride in seven of thirteen villages. The prevalence of dental mottling was high among children (5- 14 yrs) in Dharmapuri (53%), Krishnagiri (43%) and Salem (42%) district.

A research article by Yadav et al 2008 titled 'Fluoride distribution in groundwater and survey of dental fluorosis among school children in the villages of the Jhajjar district of Haryana, India'. The study revealed that fluoride content in underground water was varying in villages and school-going children (7- 15 yrs) showed different type and stage of dental fluorosis as per fluoride concentration in drinking water.

Studies carried out by the Regional Medical Research Center for Tribal Jabalpur in Mandla district of Madhya Pradesh 2004 revealed a high prevalence of Genuvalgum



(51.1%) and Dental fluorosis (74.4%). Water analysis revealed high fluoride content (9 to 13 ppm) in few villages.

Kotoky et al 2008 carried out research in Karbianglong district of Assam. The study revealed that one-seventh of the 700000 people were suffering with dental or skeletal fluorosis or both and the high concentration of fluoride found in some areas like Ramsapather (> 20.6 mg/L) and Lungnit (> 15.4 mg/L)

A research carried out by Raju et al 2009 to assess fluoride concentration in ground waters of Sonbhadra district, Uttar Pradesh. The research revealed that the source of fluoride in the ground water of the study area is mainly from geological origin and concentration of fluoride varies from 0.483 to 6.7 mg/l. Preliminary investigation revealed severe health disorders in villagers such as mottling of teeth, deformation of ligament, bending of spinal column and aging problem in most of people due to drinking of high fluoride content water.

A cross-sectional survey was conducted by Pandey 2010 in Gureda village of the Durg district of Chhattisgarh. The aim of the study was to find out the prevalence of dental and skeletal fluorosis among the population and to assess the relation between drinking water fluoride level and prevalence of fluorosis. The survey findings revealed that the prevalence of dental fluorosis was 8.2%. Dental fluorosis was higher in the 8-45 age groups. Both skeletal and dental fluorosis was more common in males and the prevalence of skeletal fluorosis increased with age. Genu varum (38.1%) and genu vulgum (6.3%) were the common skeletal deformities. Water fluoride levels ranged from 0.2 to 7.8 ppm.

The study conducted by Sahu A et al 2006 at BALCO, Korba region by iron selective electrode method, revealed that the ground water samples of 34 villages of this region had fluoride concentration values varied from 1.07 to 3.10 ppm and villagers were found suffering with dental and skeletal fluorosis.

All these studies suggest that ground water contains high fluoride concentration and consumption of fluoride content water (i.e. more than 1.5 mg/L fluoride) for longer duration is hazardous to human health and its major public health problem in some part of India.

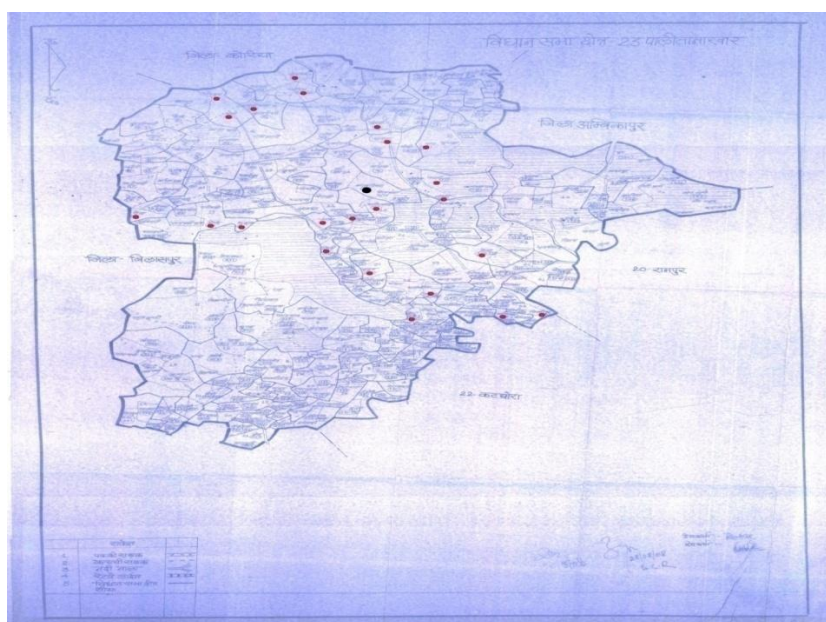
## Objectives

- 1) To confirm the presence of the problem of fluorosis
- 2) To know the pattern and the prevalence the problem
- 3) To identify safe potable water sources and suggest to community
- 4) To find out reason for high fluoride content in water, if present in as much if it is Hydrofluorosis.
- 5) To recommend and help in implementation of solutions to the problem
- 6) To offer treatment to the affected people with skeletal fluorosis.

## Study Area

Amatikra village comes under Poudi -Uproda block, Korba district, Chhattisgarh. There are three mohallas in this village like Amatikra, Devmatti and Duggupara. .Village population is approximately is 1000. Most people belong to any three main castes of Gond, Dhanuhaar and Yadavs. The dhnuhaars being poorest. The main occupation of the villagers is agriculture and cattle rearing. There is no qualified doctor or nurse resident in village and nearest PHC is at km away. The main source of drinking water is hand pumps. Reportedly, the first hand pump was dug approximately 20 years back in this village. Presently, there are twenty five hand pumps, fourteen dug wells, one pond and one tube well in the village.

## Map of Pali and Poudi area



## **Methodology**

### **Method**

Prior to starting the survey, information sharing and community consent was ensured by talking with the Sarpanch, Mitanin and a large number of villagers. The BMO of Katghora was informed too. The nature and purpose of study and oral consent was taken from the community. A cross sectional survey design was selected to study the prevalence of symptoms related to the problem. Out of total of 200 households information was collected from 131 households. Due to time constraint, houses were interviewed from all three clusters. However, water samples were taken from all water bodies. A semi-structured interview schedule was developed for study. That included information about the family; question related to disease symptoms, source of water used and some information about livestock was elicited. (See annexure for the survey form). The collected data was edited for completeness, accuracy and consistency .Data was entered in SPSS 15 (statistical package for social sciences) and data analysed by using descriptive studies and frequency tables.

### **Findings**

Information was available from total of seven hundred and forty seven (747) people in 131 surveyed families. Out of that 43 people (6%) complained of back pain and all had difficulty in doing neck and back (spinal) movements, which were confirmed on clinical testing. Of these, 13 (30% of those with pain and 2% of the total surveyed) had it severe pain which enough to affect their activities of daily living (ADLs). Difficulty in doing routine activities such as eating, bathing, dressing, toilet needs, walking and continence etc. were measures of this disability. Twenty six percentage respondents (25.58%) are having difficulty in doing bending activities (Clinical test were positive) Respondents were not able to touch their toes without bending knees.

**Table 1 Backache problem**

<b>No of respondents having backache problem</b>	<b>Frequency</b>	<b>Percentage (%)</b>
<b>Yes</b>	43	<b><u>5.75</u></b>
<b>No</b>	704	94.24
<b>Total</b>	747	100

**Table 2 Affecting ADLs**

<b>No of respondents ADLs affected</b>	<b>Frequency</b>	<b>Percentage (%)</b>
<b>Yes</b>	13	<b><u>30.23</u></b>
<b>No</b>	30	69.76
<b>Total</b>	43	100

**Table 3 Bending activities**

<b>No of respondents bending activities affected</b>	<b>Frequency</b>	<b>Percentage (%)</b>
<b>Yes</b>	11	<b><u>25.58</u></b>
<b>No</b>	32	74.41
<b>Total</b>	43	100

Forty eight ( 48) children among in 131 households had teeth problem such as dull, yellow – white spots appear on surface of teeth, staining and pitting of teeth, damage of enamel ( see picture)

Only children are suffering with teeth problem whereas adults are suffering with backache problem. Many young adults were taking support of stick while walking.

Study of water bodies in the village –

There are total forty one water bodies (41), the distribution is as follows clearly, majority of families who were surveyed, used hand pumps as their main source of drinking water.

**Table 6 Source of drinking water**

Source of drinking water	Frequency	Percentage (%)
Well	20	15.26
Hand pump	105	<b>80.15</b>
Well and Hand pump	3	2.29

Out of forty one water bodies' sample, two samples were inadequate

**Table 4 Result of Water Fluoride**

No. of samples tested	No, of samples with high fluoride >1 ppm	Range (ppm)
40	<b>20</b> <b>(50%)</b>	0.21 – 12.0

There are total twenty five hand pump. Water from all hand pumps is tested for fluoride level except two as the samples were inadequate. Eighteen (18) hand pumps (78%) of twenty three have high fluoride content i.e. more than 1ppm and seven (7) hand pumps have a value higher than or equal to 5ppm.

Joba pond water contents very high level of fluoride i.e. 12 ppm and

In one tube well also contents higher level of fluoride i.e. 6 ppm

**Table 5 Result of Water fluoride in water sources**

<b>Water bodies</b>	<b>Number in the village</b>	<b>No: (%) with high fluoride levels</b>	<b>No: (%) with normal fluoride levels</b>	<b>Range of fluoride levels</b>
<b>Hand pumps</b>	<b>25</b>	<b>7 (30.43%)</b>	<b>6 (26.08%)</b>	<b>High: 5.1 – 10 ppm Normal: 0.26 – 1.0 ppm</b>
<b>Tube Well</b>	<b>1</b>	<b>1 (100%)</b>	<b>0</b>	<b>6.0 ppm</b>
<b>Pond</b>	<b>1</b>	<b>1 (100%)</b>	<b>0</b>	<b>12.0 ppm</b>

Urine sample were collected from seven of the affected patients who were seen then. Urine samples of all 7 patients showed more than 2 ppm fluoride confirming the diagnosis of skeletal fluorosis in them. In fact the levels were higher than 5 ppm in all.

**Table 6 Results of Urine fluoride**

<b>No. of samples tested</b>	<b>No, of samples with high fluoride &gt;2 ppm</b>	<b>Range (ppm)</b>
<b>7</b>	<b>7 (100%)</b>	<b>5.6 – 17.0</b>

We also looked for problems related to fluoride in animals. While we did not do a formal survey we found that only 2 (2%) of animals are having teeth problem

Seventy five percentage (75%) respondents are having domestic animals, among that only two percent (2.04%) of animals are having teeth problem.

## Clinical representation of index cases

### CASE 1

**Name of the Patient** – Mr. Bholu Sigh.

**Age** – 50 yrs

**Weight** – 37.1kgs

**Diagnosis** – Pulmonary Tuberculosis, Skeletal Fluorosis and bilateral dense cataract

**Chief complaint** – Patient is having cough with expectoration, haemoptysis and weight loss since one and half year, he is having sever back pain and fever

**Physical Examination** – He is not able to touch chin to manubrium sternum and touch toes without bending knee (Clinical test are positive)

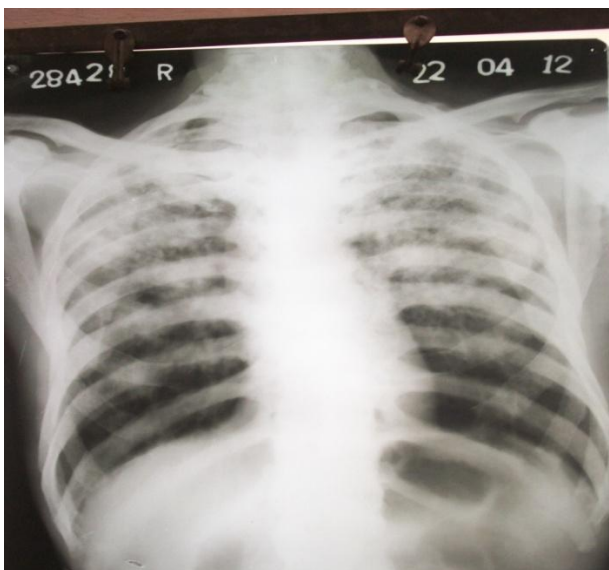
### **Investigation**

Hb - 9.9%

ESR- 100mm/hr

Sputum -Positive

**X- Ray of chest** – Findings showed bilateral infiltration of lobe, spine and rib cage were looking dense white.



## Treatment –

- 1) Treatment for Tuberculosis – INH 300 mg OD  
RIF 450mg OD  
EMB 800mg OD  
PYZ 1000mg OD  
Pyridoxin 10mg OD  
Ferrifol BD
- 2) Treatment for Fluorosis – Calcium tablet and Amla 1 month

## CASE 2

**Name of the Patient** - Mr. Ved Prasad

**Age** – 45 yrs

**Weight** – 59.3kgs

**Diagnosis** – Skeletal Fluorosis

**Chief complaint** – patient is having back and hip pain since 3-4 yrs. Weakness and reduces appetite.

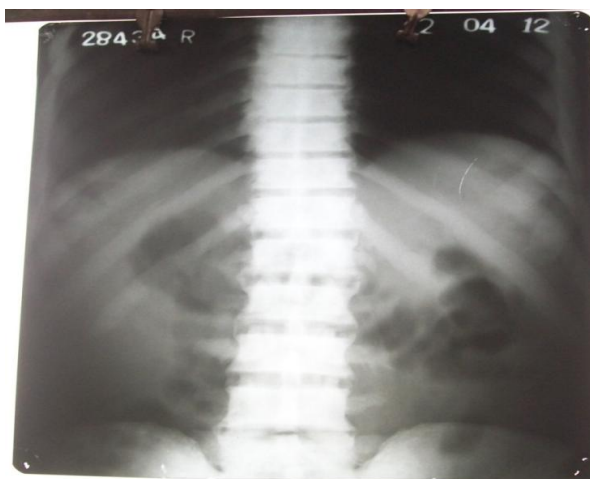
**Past History** – pain was started from feet and gradually it increased

**Physical examination** – He is not able to touch chin to manubrium sternum and touch toes without bending knee (clinical test are positive)

**Investigation:** Hb – 8.8%

ESR – 0.5mm/hr

**X – Ray of spine** – showed classical fluorosis picture (dense white spine)



4





## **Treatment -**

- 1) Ferrifol Tablet 1 month
- 2) Saral churna 1 month
- 3) Kuashoyar gugulu 10 days
- 4) Nirdundi oli
- 5) Technique of making defluoridation of water

## **Discussion and Conclusion**

There are ample numbers of water sources available in Amatikra village. For 1000 population, there are total forty two water sources in the village. The forty two sources comprise of twenty five hand pumps, fourteen wells, a tube well and a pond. Among all the 25 hand pumps, water from eighteen pumps contains more than 1 ppm fluoride and from seven hand pumps contains more than 5 ppm. One tube well and one pond (generally pond contains surface water and fluoride is seen in ground water) water have higher level of fluoride i.e 6ppm and 12 ppm respectively.

Because of consumption of fluoride content water for longer period, six villagers are suffering with sever back pain and their urine sample also reveals that fluoride content is more than 2ppm which confirms the diagnosis of skeletal fluorosis in them. Five villagers are suffering with mild or moderate back pain. More than one fourth adults' daily living activities and bending activities are affected (bending from hip joint without bending knee joint). Forty eight children in 131 households are suffering with dental fluorosis stage 3. Similar findings has reported in studies conducted in different part of India (Choubisa 2001, Murugan A et al 2011, Harikumar et al 2007, Yadav et al 2008, Chakma T.et al 2004, Kotoky et al 2008, Raju et al 2009, Pandey A 2010, Sahu A et al 2006).

Upto a specific amount of fluoride intake (i.e. 1mg/L) is good for human health which helps to prevent tooth decaying but excess of it (i.e. more than 1.5mg/L) causes skeletal, dental and non-skeletal manifestation or any combination of the above and in final stages it causes premature aging. Patients who are suffering with fluorosis may live 70 years but an unproductive and painful life.

Higher concentration of fluoride is seen in ground water than surface water. The source of fluoride in ground water depends on geological occurrences (i.e. fluoride bearing minerals viz. Apatite and Biotitic mica). Water drawn from shallow hand pumps contains less minerals and salts than hand pumps which are dug more than 250 feet. As you dig deeper, water will contains more minerals and salts.

The present study reveals that in Amatikra village, villager's main source of drinking water is hand pumps which may be dug more than 250 feet and because of this high fluoride concentration is seen in hand pump water. Due to consumption of fluoride

content water, more than one forth adults and many young children are suffering with skeletal and dental problems. It is slowly making them unproductive and they are living painful life. So it is major public health problem affecting the health and livelihood of villager's in Amatikra village. There is urgent need to aware villagers about this issue and it should be made mandatory that water from all the hand pumps in the area is evaluated for fluoride content before used by the community or people.

## **Recommendations**

Fluorosis is not reversible disease; JSS team suggested the following public health action to address this problem which will help to prevent progression of disease especially in children and who is suffering with mild / moderate back pain problem. The following suggestions are given by JSS team after the survey.

1. Inform the villagers about the problem of high fluoride content in selected hand pumps, tube well and pond. Advised them to use alternative water source whose fluoride content is low and refrain from using high fluoride content water bodies.
2. JSS team taught villagers Nalgonda Technique for de-fluoridation – Raw water mixed with aluminium sulphate (alum), Lime or sodium carbonate. Stir water for 10 -20 minutes and allow settling for nearly one hour. Withdraw supernatant and discard sludge.
3. JSS team taught villagers about disinfecting well water - In five litre water, add 250 gm bleaching powder and filter it for three times with cloth and store in bottle. Two drop of this water is sufficient to disinfect one litre of water. JSS team distributed Chlorine water and droppers to villagers.
4. Distributed Calcium tablet with vit.D and Aamala (for vit.C) for one month who suffering with severe backache and stiffness.

## Appendix 1:

### Results of Water Fluoride

Village- Amatikra, Block Podi Uproda

Dist. -Korba

Sample No	Name	Address of Water Source	Source of Water	F- in ppm	Remark
1	Patthar Singh	Aamatikra, Ward No.7	Hand Pump	10.0	
2	Mahipal	Aamatikra	Hand Pump	9.4	
3	Lakhan Singh	Aamatikra, Ward No.9	Hand Pump	9.4	
4	Mohan Singh	Aamatikra, Ward No.6	Hand Pump	7.3	
5	Kadam Singh	Aamartikra	Hand Pump	6.4	
6	Jagatsay	Aamatikra, Ward No.9	Hand Pump	5.2	
7	Basant singh	Aamatikra	Hand Pump	5.1	
8	Lalsay	Duggupara	Hand Pump	4.4	
9	Rukhmaniya Bai	Aamatikra	Hand Pump	3.4	
10	Patiram	Devmatti, Ward No.4	Hand Pump	3.4	
11	Samaru Singh	Aamatikra, Ward No.10	Hand Pump	3.2	
12	Gorelal	Aamatikra, Ward No.8	Hand Pump	2.8	
13	High School-1	Aamatikra	Hand Pump	2.6	
14	High School-2	Aamatikra	Hand Pump	2.4	
15	Dhanukdhari	Devmatti	Hand Pump	2.3	
16	Pancham Singh	Aamatikra, Ward No.8	Hand Pump	1.6	
17	Amritlal	Aamartikra	Hand Pump	1.3	
18	Kewala Singh	Aamatikra,	Hand Pump	1.1	

		Ward No.7			
19	Laxmi	Devmatti	Hand Pump	1.0	
20	Pahalwan	Devmatti	Hand Pump	0.97	
21	Gulab Singh	Devmatti	Hand Pump	0.51	
22	Dhan Sai	Devmatti, Ward No.3	Hand Pump	0.32	
23	Ramji	Devmatti, Ward No.5	Hand Pump	0.26	
24	Sundar	Devmatti	Hand Pump	-	SNS
25	Budhram	Aamatikra,	Hand Pump	-	SNS
26	Joba Pond	Aamartikra	Pond	12	
27	Sanich Ram	Aamatikra	Tube Well	6.0	
28	Jai Singh	Aamatikra	Well	1.0	
29	Samaru	Aamatikra	Well	0.82	
30	Panchayat Bhavan Ke Paas	Aamatikra	Well	0.73	
31	Shyamlal	Duggupara	Well	0.73	
32	Baldev Singh	Aamatikra, Ward No.1	Well	0.71	
33	Budhsay	Devmatti	Well	0.69	
34	Rup Narayan	Aamatikra	Well	0.57	
35	Rugu	Duggupara	Well	0.51	
36	Vishram	Duggupara	Well	0.43	
37	Ran Singh	Aamatikra	Well	0.35	
38	Hari Gond	Aamatikra	Well	0.34	
39	Itwara	Devmatti	Well	0.31	
40	Pahalwan	Devmatti	Well	0.28	
41	Bifaeeya	Devmatti	Well	0.21	

Note: SNS – Sample not sufficient

### **Results of Urinary Fluoride**

<b>Sr.No</b>	<b>Patient Name</b>	<b>Problem</b>	<b>Back stiffness</b>	<b>Fluoride in ppm</b>	<b>Remark</b>
1	Bilasiya	back pain		17.0	
2	Kadam Bai	back pain		16.0	
3	Basant Kuvar	back pain	Severe	16.0	
4	Mankuvar	back pain		16.0	
5	Hinglaso	back pain	Severe	9.1	
6	Jagdev	back pain		5.6	
7	Vedprakash	back pain	Severe	5.6	
8	Jagdhis Prasad	back pain		-	SNS
9	Rajman Bai	back pain	Severe	-	SNS
10	Urmila	back pain	Severe	-	SNS
11	Ram Khilavan	back pain	Severe	-	Sample not received

Note: SNS – Sample not sufficient

**Appendix 2:**

**Pictures of children (Dental fluorosis)**



## Appendix 3

### Pictures of Adult (Skeletal fluorosis)





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