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Physico - Chemical Study of Some Fluorosis Affected Child Dental Caries and Their BMI Value In Rajauli Sub-Division of Nawada District of Bihar

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ABSTRACT

Fluorosis is an endemic problem in Rajauli Sub-Division of Nawada District in Bihar, India. Nawada and Gaya district in Bihar is the worst affected areas of Fluorosis. The aim of this study was to determine whether a relationship exist between the groundwater fluoride (F^-) concentration, dental caries in children and their Body Mass Index (BMI) values in children living in Rajauli Sub-Division of Nawada district of Bihar in India. Except for some small villages, ten villages is Rajauli Sub-Division with only groundwater source and essentially the same socio-economic living standards and nutritional conditions were surveyed. All of the children in each village in the age group of 6 to 12 were sampled for a total of about 500 children in all villages. Fluoride (F^-) level in the village ground drinking water measured by the SPAND's method ranged from 1.5 to 4.5 mg L^{-1} while number of decayed (Dt) permanent teeth per child range between 3 to 8 and the number decayed deciduous (dt) range between3 to 13. Over this narrow concentration range, there appeared to be significant association between the fluoride (F^-) level in a drinking water and (Dt) and (dt) but BMI value of the children, boys and girls vary according as the concentration of F^- level in drinking water. However, the village with the highest water F^- level concentration and the lowest caries score is omitted, linear regression analysis show weak increase of the Dt and dt scores with increasing water F^- levels concentration, regardless of age, for both boys and girls in the remaining ten villages.

Keywords: Nawada District, Rajauli Sub-Division, Gaya District, Dental carries, Fluoride (F^-) level in drinking groundwater and BMI value.

INTRODUCTION

Endemic fluorosis resulting from high fluoride concentration in groundwater is a public health problem in India. The available data suggest that 15 States in India are endemic for fluorosis (F^- level drinking water > 1.5) five of these have category III (>50% of the districts affected) with includes Bihar and Gujarat [1]. The Assam region of North East India has also been recognised as a fluoride affected area [2]. World

health Organisation (WHO) has set the upper limit of F^- concentration in drinking water at 1.5 mg L^{-1} [3]. The bureau of Indian Standards has therefore, laid down Indian Standard as 1.0 mg L^{-1} as maximum permissible limit of fluoride with further remarks as lesser the better [4]. The WHO in oral health report (2003) [5] has stated Fluoride as most effective agent in dental caries prevention.

Besides damaging bones and teeth, excessive intake of fluoride (F^-) is known to cause a wide range of adverse health effect. Since drinking water is usually the main source of F^- intake, determination of groundwater F^- concentration has been an important undertaking in many countries to investigate its potential effects on public health, especially in relation to the occurrence of dental caries and dental Fluorosis [6-10]. In this study we examined the relationship between dental caries in children and the fluoride contained groundwater using for drinking and cooking purpose in 10 villages of the Rajauli Sub-Division area.

The objectives of this study were to measure the prevalence of dental fluorosis, dental caries and skeletal deformation in the population residing in areas with high and normal level of fluoride in the drinking water, and to find out whether high fluoride level in drinking water is more protective for dental caries or a risk factor for dental fluorosis.

MATERIALS AND METHODS

This study was conducted from October 2014 to March 2015 in 10 villages in Rajauli Sub- Division, Bihar of India. The Climate is hot and dry in summer and mild in winter. Except for some small villages 10 villages in that area was selected for study, rely for their drinking water on local groundwater sources with varying Concentration of F^- level. The selection of these villages was done in such a way that all of them have essentially the same socio-economic standards and nutritional conditions. Most of villages have the similar public health and dental care. All the children aged 6 to 12 in each village were examined. Included in total of 500 children were 250 boys and 250 Girls. The Dt (Decayed permanent teeth) and dt (Decayed deciduous teeth) of the children in each village were determined according to the WHO standard [**11]** by two dentists from Patna using a sharp dental probe and mouth mirror under good natural light. For the fluoride (F^-) analysis, standard SPANDS method was used with a Systronics company spectrophotometer by following procedure. The samples collected from the 10 Villages are shown in the fig 1 and Village Names also mentioned

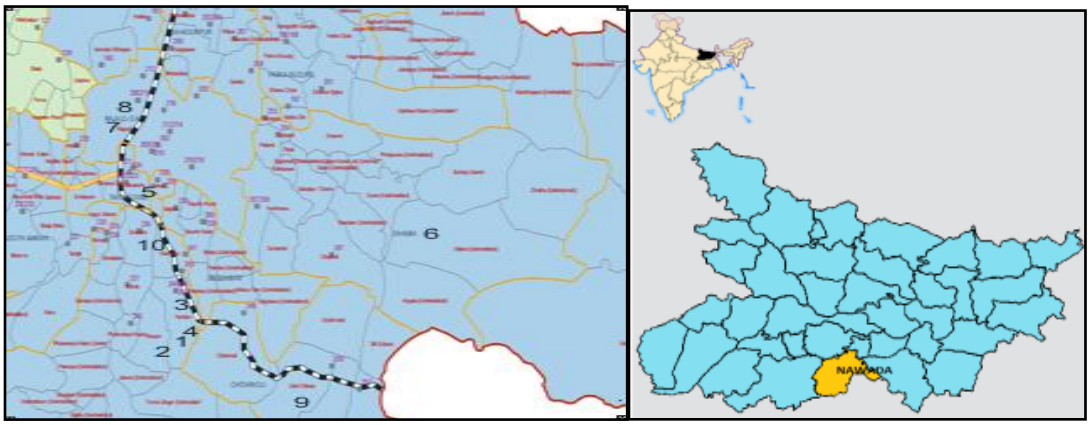

Fig 1: Identification and location of 10 villages in the part map of Rajauli Sub-Division,
Fig1A: Location of of Nawada District in Bihar Map

1. Kachahariyadih, 2. Mushlim Tola, 3. Haldia (Hardiya) Sector-I, 4. Haldia (Hardiya)Sector- II, 5. Takauatand, 6. Dhamni, 7. Rajauli Mohalla Near (PS), 8. Rajauli Mohalla (SDM office), 9. Garh dibaur, 10. Choutha

Procedure:

Standard fluoride solution: Intermediate fluoride solution of 2, 4, 6, 8, and 10 mL was taken and then diluted to 50ml with distilled water. After dilution added 10ml acid zirconyl SPADNS reagent and allowed to stand the standard solution for 10 min for completing the reaction between fluoride and acid zirconyl SPADNS reagent. After 10 min we saw the sample on the spectrophotometer at the wavelength 570nm, and draw the calibration graph, absorbance against concentration of the standard sample. From this calibration graph we found out the concentration of unknown sample of water. Reference solution was considered as blank for fluoride detection.

Sample treatment: 50mL sample of waste water or water was taken and added few drop of sodium arsenite solution to reduce the interference of chloride, then added 10ml acid zirconyl SPADNS reagent allowed to stand for 10 minutes for completing the reaction. Then saw the sample on the Systronics company spectrophotometer at wavelength 570nm and note down the absorbance of the sample, and found out the value of fluoride from the calibration graph prepared by standard fluoride solution.

Calculation:

$$F^-(mg\ L^{-1}) = (A / mL\ sample) \times (B/C)$$

where A = µg F^- determined Spectrophotometrically. The ration B/C applies only when a sample is diluted to a volume B, and portion C was taken from it for colour development [12].

Data were computerized and analyzed using the statistical package for social science. Linear regression analysis was used to examine the relationship between the F^- concentration in the drinking water with caries in permanent teeth (Dt), deciduous teeth (dt) and their BMI Value [**13].**

BMI Weighing Scale: We studied BMI scale of the people of kachahariyadih, Mushlim tola, Garh dibur and Chautha we found that they were under weight and anaemic. Majority people of this area have lower BMI value and have poor health.

WHO defines as the weight in kilos divided by the square of the height in meter or kg per meter ^{2}. For example an adult weighing 70kg and whose height in 1.75 meter will have a BMI of 22.88.

$$BMI = 70kg/ (1.75\ m)^2 \text{ or } 70/ 3.06= 22.88$$

The BMI was invented by Adolphe Quetelet between 1830 and 1850 [**14].** A scientist named Ancel Keys first used the term *body mass index* in 1972 [**15].** He wrote that governments should measure the BMI of adults to find out whether they are too fat or too thin.

Overweight or Not?: Health organisations, including the World Health Organisation (WHO), use the BMI to help in deciding whether people are too fat or too thin. The WHO uses these numbers for adults [**16].** International Classification According to BMI is presented in table 1.

Table 1

Underweight	---	up to 18.5
Severe thinness	---	up to 16
Moderate thinness	---	16 to 16.99
Mild thinness	---	17 to 18.49
Normal	---	18.5 to 24.99
Overweight	---	25 to above
Pre obese	---	25 to 29.99
Obese	---	30 above
Obese class I	---	30 to 34.99
Obese class ii	---	35 to 39.99
Obese class iii	---	40 to 45
Super obese	---	45 and above

The Waist Hip Ratio is for Male is 0.90 to 0.95 m (Normal), for Female is 0.80 to 0.85 m (Normal)
It is recommended to remain in the above range if you want to remain fit and smart.

$$BMI=WEIGHT/(HEIGHT\ IN\ M)^2$$

Our team which had earlier extensively studied the cases in some fluorosis endemic villages of Rajauli Block of Nawada district of Bihar has recently undertaken BMI studies of many of the dental fluorosis and skeletal deformation victims of these villages and shown in fig 2,3.

Figure 2. Photographs of Skeletal Deformed in Rajauli Sub- Division of Bihar, India

Figure 3: Photographs of Dental caries with Fluorosis in Rajauli Sub- Division of Bihar, India

RESULTS AND DISCUSSION

The population and the number of children examined in each village are shown in tables2, 3. The concentration of F^- level in all 10 villages groundwater was found to vary widely from 1.5 to 4.5 mg L^{-1}. However, in Kachahariyadih, Mushlim tola, Chautha and Garh dibaur villages the F^- concentration was found 4.5, 4.1, 3.4 and 3.3 mg L^{-1} shown the fig 4. The Dt values of above four villages was reported as 14,13,12,11 and dt values were found 13,11,11, 9 and Sd values were found 8,6,5 and 4. It seems that the Dt, dt and Sd values have linear correlation between increasing the F^- level content of the groundwater and increasing trend of Dt, dt and Sd for both girls and boys of different age groups in the remaining villages, as it is shown for girls children in figs- 5-7 and for boys children in figs 10-12. Fig 8 shows the relationship between Dt, dt and Sd values of Kachahariyadih, Mushlim tola, Chautha and Garh dibaur villages. Higher F^- concentration is also found in these villages as 4.5, 4.1, 3.4 and 3.3 mg L^{-1}.

The BMI value of girls and boys was found inversely proportional to the concentration of F^- level that is BMI value of Hardiya Sectore-I is highest as 17.6 but BMI value of girls Child of kachahariyadih is lowest 14.8, This data indicates that major chunk of girls population of Kachahariyadih, Mushlim tola, Chautha and Garh dibaur villages have poor health and anaemic as shown the fig 4, fig 9 and fig 14.

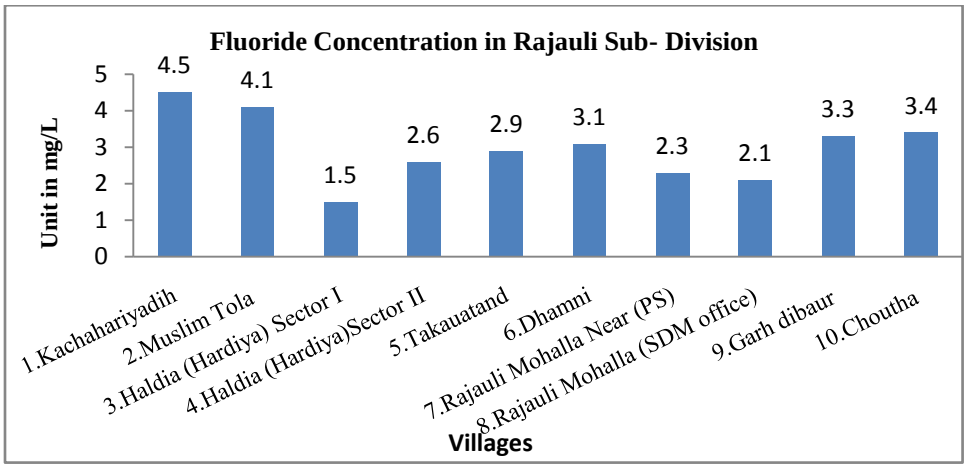

Figure 4 Fluoride Concentrations in Rajauli Sub-Division of Nawada,

Table- 2 Rajauli Sub- Division village population and Subject Sample information

Sl No.	Name of the Village	Population	No. of children examined	Girls					
				Dt	dt	Sd	Nd	Mean F^- (mg/L)	BMI Mean value
1	Kachahariyadih	280	25	14	13	8	0	4.5	14.8
2	Mushlim Tola	430	25	13	11	6	0	4.1	15.0
3	Haldia (Hardiya) Sector I	4000	25	3	2	1	19	1.5	17.6
4	Haldia (Hardiya)Sector II	3900	25	5	4	2	14	2.6	16.5
5	Takauatand	2500	25	9	7	3	6	2.9	16.2
6	Dhamni	2815	25	10	8	4	3	3.1	15.8
7	Rajauli Mohalla Near (PS)	1500	25	6	5	1	13	2.3	16.9
8	Rajauli Mohalla (SDM office)	1300	25	4	3	1	17	2.1	16.8
9	Garh dibaur	1717	25	11	9	4	1	3.3	15.1
10	Choutha	2075	25	12	11	5	0	3.4	15.0
	Total	**20517**	**250**	**87**	**73**	**35**	**73**	**Avg 2.98**	**15.97**
			Min	**3**	**2**	**1**	**0**	**1.5**	**2.98**
			Max	**14**	**13**	**8**	**19**	**4.5**	**1.5**

Where- Dt = Decayed permanent teeth, dt = Decayed deciduous teeth, Sd = Skeletal deformation, Nd = Non Deformation or No any decayed

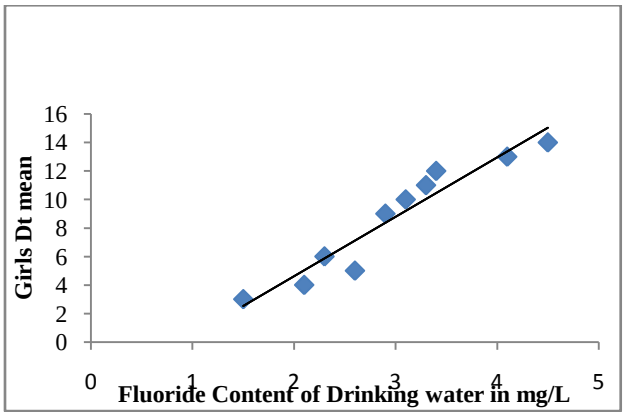

Figure 5. Relationship between fluoride content and mean of Dt value of Girls Children

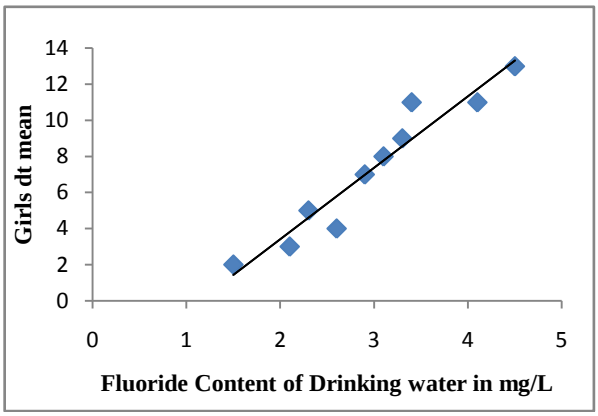

Figure 6. Relationship between fluoride content and mean of dt value of Girls Children

In table 3, the Dt, dt and Sd values in the 10 villages is found in the range between 2 to 15, 1 to 13 and 1 to 7 and it also have the linear correlation between the increasing F^- content of the groundwater as it is reported from fig 10, fig 11 and fig 12. As seen in fig13 that the relationship between Dt, dt and Sd values have correlation with the content of F^- level in ground water. The value of Dt, dt and Sd is higher in Kachahariayadih , Mushlim tola, Chautha and Garh dibaur as F^- content of these villages are 4.5, 4.1, 3.4 and 3.3 mg L^{-1}.

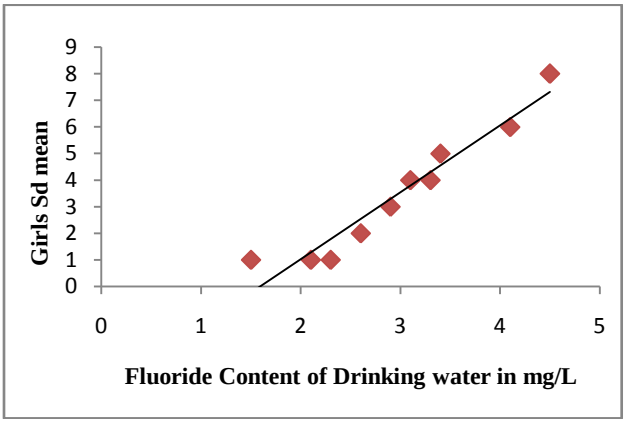

Figure 7. Relationship between fluoride content and mean of Sd value of Girls Children

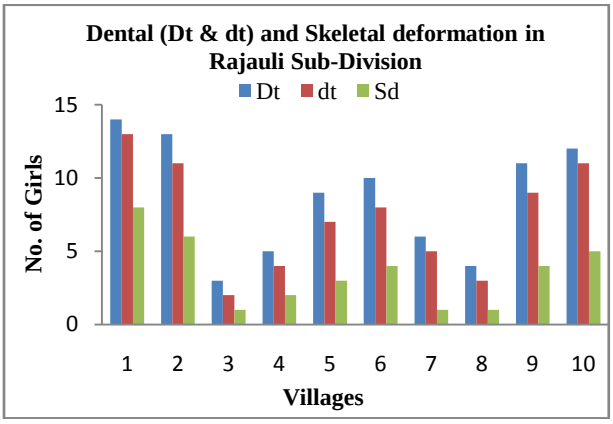

Figure 8. Relationship between fluoride content and mean of Dt, dt and Sd value of Girls Children of F^- Concentration in villages

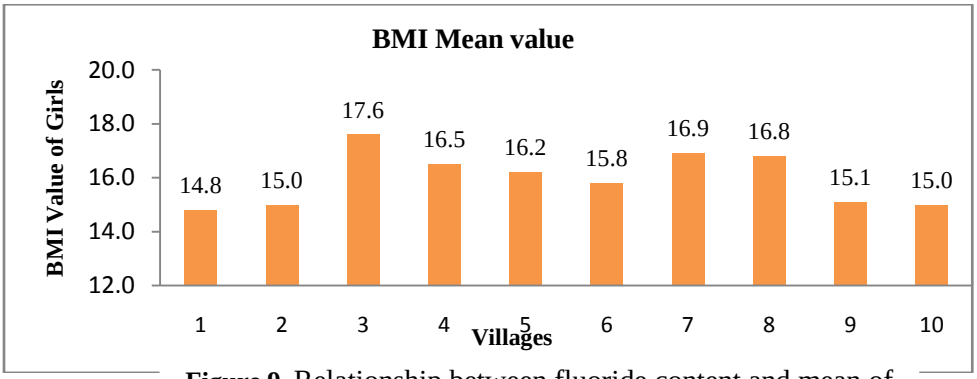

Figure 9. Relationship between fluoride content and mean of BMI value of Girls Children

Table 3. Rajauli Sub- Division village Population and Subject Sample information

Sl No.	Name of the Village	Population	No. of children examined	Boys					
				Dt	dt	Sd	Nd	Mean F^- (mg/L)	BMI Mean value
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2	Mushlim Tola	430	25	14	12	6	0	4.1	15.6
3	Haldia (Hardiya) Sector I	4000	25	2	1	1	21	1.5	19.0
4	Haldia (Hardiya)Sector II	3900	25	4	3	2	16	2.6	16.5
5	Takauatand	2500	25	10	6	2	7	2.9	16.1
6	Dhamni	2815	25	11	7	4	3	3.1	16.5
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9	Garh dibaur	1717	25	11	10	3	1	3.3	15.6
10	Choutha	2075	25	14	11	6	0	3.4	15.3
	Total	**20517**	**250**	**89**	**69**	**33**	**82**	**Avg 2.98**	**16.42**
			Min	**2**	**1**	**1**	**0**	**1.5**	**2.98**
			Max	**15**	**13**	**7**	**21**	**4.5**	**1.5**

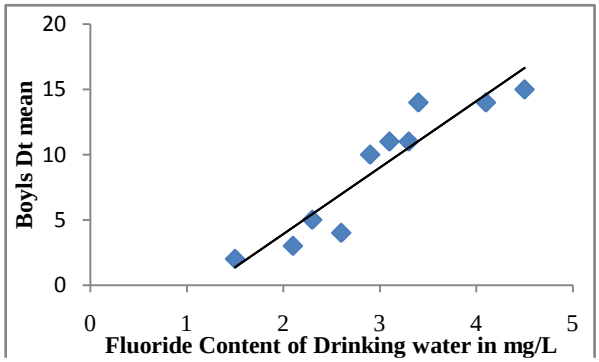

Figure 10. Relationship between fluoride content and mean of Dt value of Boys Children

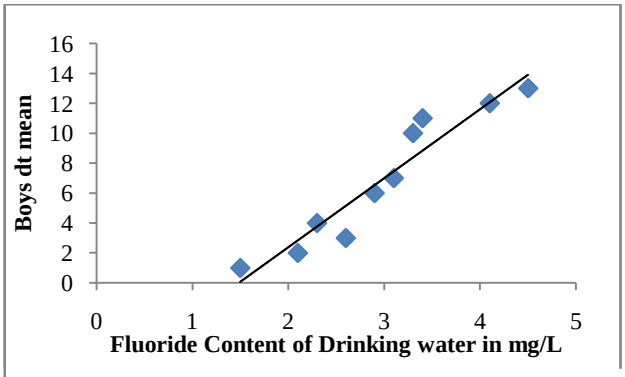

Figure 11. Relationship between fluoride content and mean of Dt value of Boys Children

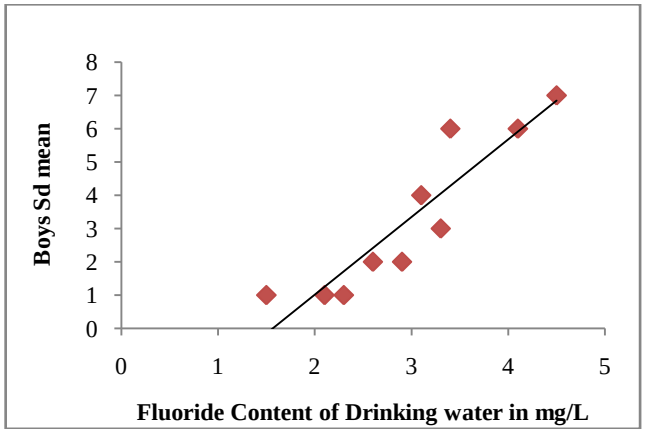

Figure 12. Relationship between fluoride content and mean of Sd value of Boys Children

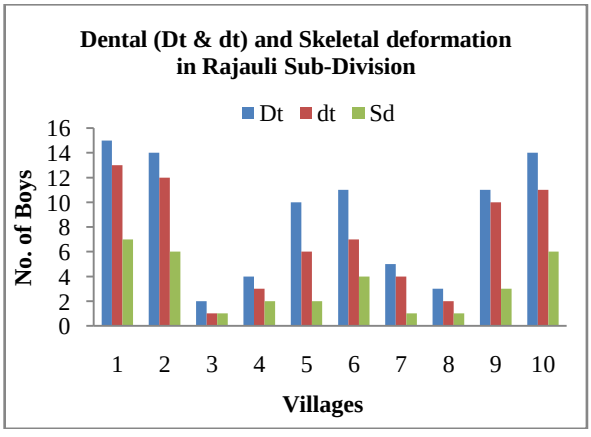

Figure 13. Relationship between fluoride content and mean of Dt, dt and Sd value of Boys Children of F^- Concentration in villages

Fig 14 reveals that BMI value and health is also very poor for the boys of Kachahariyadih, Mushlim tola, Chautha and Garh dibaur. The BMI value of Hardiya sector-I is satisfactorily. When our team visited (Haldiya) Hardiya Sector-I and Hardiya Sector-II villages, it was found that in some area drinking water is being supplied from water tower supply system by PHED of Government of Bihar and this water has F^- concentration between 0.5 to 1.5 mg L^{-1} which is within permissible limit.

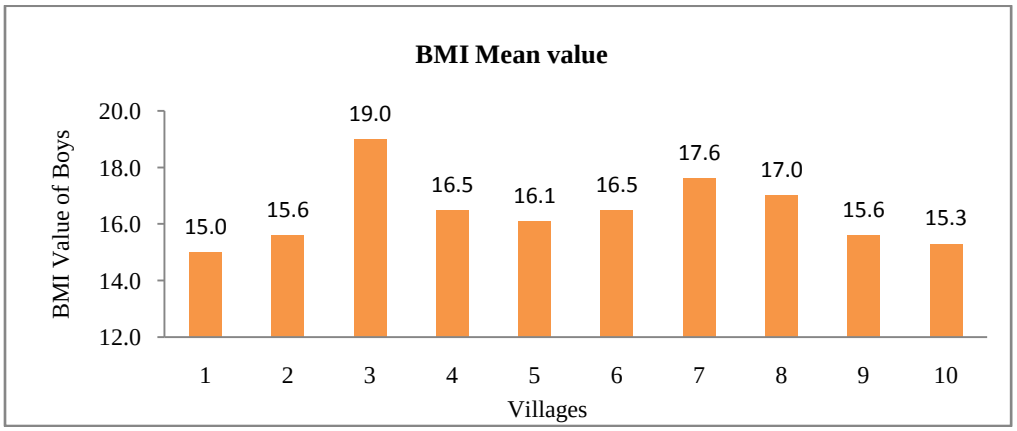

Figure14. Relationship between fluoride content and mean of BMI value of Boys Children

APPLICATIONS

The objective of the present study is to create a database which will be used while working for ameliorative and preventive measures against fluorosis in the area. The aim of this work is to motivate others (philanthropic persons/ organization/ corporate sectors etc) to work for the benefits of the victims of fluorosis through availability of fluoride free drinking water and through spread awareness against fluorosis and the like. Long terms objective of this study is to save future generations of fluorosis affected areas from the evils of fluorosis.

We organised several public meeting in Rajauli, Hardiya, Mushlim tola and Kachahariyadih to make people aware about the injurious effect of F^- content in drinking water. Local MLA, SDO, DSP, Mukhiya , pramukha, and many local dignitries attended that meetings. We also made the appeal through the news papers from the government of Bihar to provide F^- free water in that area. It worked and now government of Bihar made available F^- free water in this area by water supply system. Government of Bihar also installed FRC (Fluoride Removal Centre) unit in some villages Rajauli Sub- Division but F- free water is being misused and no one to care that.

CONCLUSIONS

The present study confirms that higher fluoride content in drinking water sources is responsible for physical deformaties, dental caries and lower BMI value among the people of 10 villages of Rajauli Sub-Division in Nawada District of Bihar. Out of 10 villages the situation of four villages Kachahariyadih, Mushlim tola, Garh Dibaur and Chautha is more vulnerable. The suffering of the people in these villages due to high fluoride content demands immediate attention. The defluoridation filters and hand pump attachment provided to the villages by UNICEF should be properly maintained, so that people should have assured facility to have fluoride free water for drinking purposes.

It would be a very effective and permanent solution to the problem if some alternative sources of drinking water are explored for these villages which are free from fluoride concentration. It is also suggested that an

extensive analysis of water quality should be done in all the villages lying within a radius of 10 to 12 Km from Rajauli Sub-Division for the presence of fluoride content.

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