



ISSN : 0973-7057

## Studies on health status of fluorosis suffering inhabitants of Rajauli, Bihar

Bihari Singh<sup>a</sup>, Anil Kumar Singh<sup>b</sup> & Peeyush Kumar<sup>c\*</sup>

<sup>a</sup>Department of Environmental Sciences, Nalanda Open University, Patna, Bihar, India

<sup>b</sup>Department of Chemistry, A.N. College, Patna, Bihar, India

<sup>c</sup>Department of Environmental Science, Magadh University, Bodh Gaya, Bihar, India

Received : 05<sup>th</sup> January, 2023 ; Revised : 05<sup>th</sup> February, 2023

**Abstract-** The intake of fluoride rich water above the maximum permissible limit of 1.5 mg/L leads to a disease called fluorosis. Rajauli block of Nawada district, Bihar is one of the worst fluorosis endemic areas. Inhabitants suffering from dental, skeletal and non-skeletal fluorosis have been found in the villages of Rajauli block. Out of the 44 samples analysed from four villages of Rajauli, 41 water samples were contaminated with fluoride. To identify the fluorosis affected people, health status survey was done. The height and weight of the villagers (who were above 6 years of age) were measured and the BMI (Body Mass Index) values were calculated. During the health survey many people of the village reported dental problems, muscular pains, joint pains, bone deformities and many more ailments related to fluorosis. Some cases of knock knee and bow legs were also observed. Many of the inhabitants had their BMI level less than 18.5.

**Key words:** fluorosis, endemic, contaminated, deformities, ailments

### INTRODUCTION

Water is one of the most important resources needed by all living forms to sustain life on the earth. Out of the available global water only 0.5% is available for domestic purposes.<sup>1</sup> Water from wells, tube wells, bore wells, lakes, rivers etc. which are sources of fresh water are used directly or indirectly for domestic purposes. However there are many water sources that have got contaminated due to water pollution.<sup>2</sup> Not only the surface water but also the groundwater is facing problem due to contamination by many chemicals, compounds, elements, ions, etc.<sup>3</sup> One such contamination in groundwater is caused due to fluoride (F<sup>-</sup>) ions. The maximum permissible limit of fluoride in drinking water as per the WHO guidelines is 1.5 mg/L.<sup>4</sup> Intake of fluoride rich water above the

permissible limit of 1.5 mg/L leads to a disease called fluorosis- a severe bone disease.<sup>5</sup> The district of Nawada is one among the 11 districts of Bihar where groundwater is contaminated by fluoride ions. The Rajauli block of Nawada district is one of the worst fluorosis endemic areas.<sup>6</sup>

Many villages in Rajauli including Hardia, Hanuman Nagar, Singar Khas, Bhaunr and Kachhariadih have visible cases of fluorosis.<sup>7,8</sup> The health status of the fluorosis affected inhabitants was not good. People suffering from dental fluorosis (moderate and severe), skeletal fluorosis (knock-knee and bow legs) and non-skeletal fluorosis were found in the villages. The BMI values of many inhabitants was found lower than 18.5. The intake of nutritious food by the villagers was very poor.

### MATERIALS & METHODS

#### Collection Of Water Samples

\*Corresponding author :

Phone : 9608396566, 7739530164

E-mail : peeyush.kumar90@gmail.com

The different villages of Rajauli where the groundwater is contaminated by fluoride was identified by sampling and testing the groundwater sources by the ‘Aquasol Kit’. The samples were collected from Jazpur (Hardia Sector D), Hanuman Nagar , Singer Khas , Bhaunr villages of Rajauli block of Nawada district. Water from different groundwater sources were collected during 2018 and 2019. Water was collected from hand pumps and bore wells -the depth of which ranged from 80 ft to 130 ft.

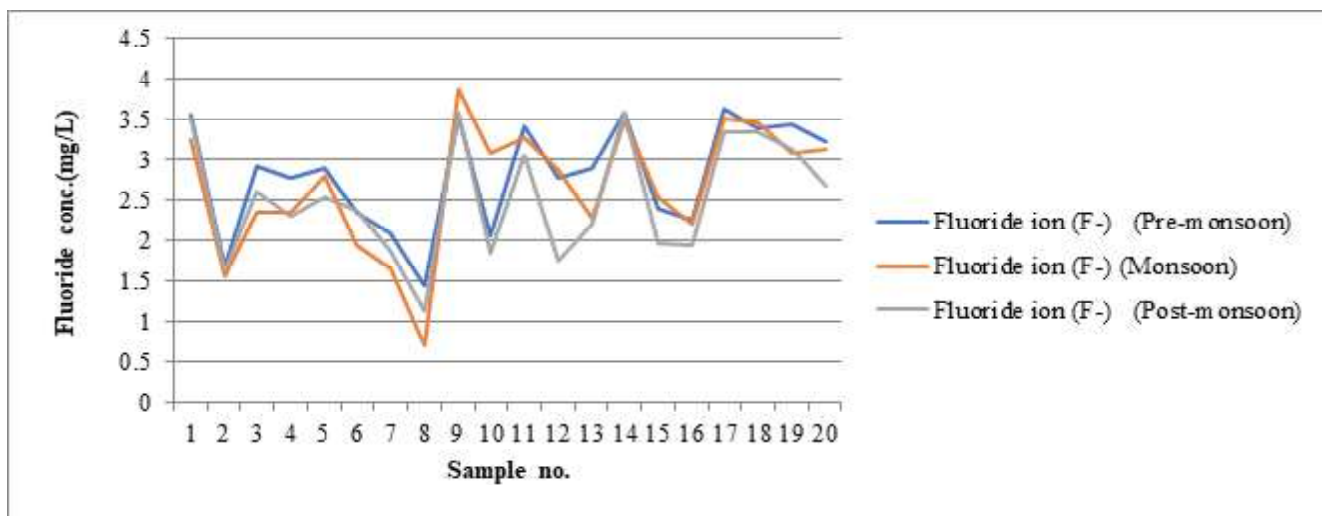
**Testing of the samples for fluoride contamination**

Water samples were collected in 1 L size plastic bottles from the villages. The water samples were collected during pre-monsoon, monsoon and post-monsoon periods of 2018 and 2019. The samples were then analysed by the Ion Selective Electrode Method in the Centre for Fluorosis

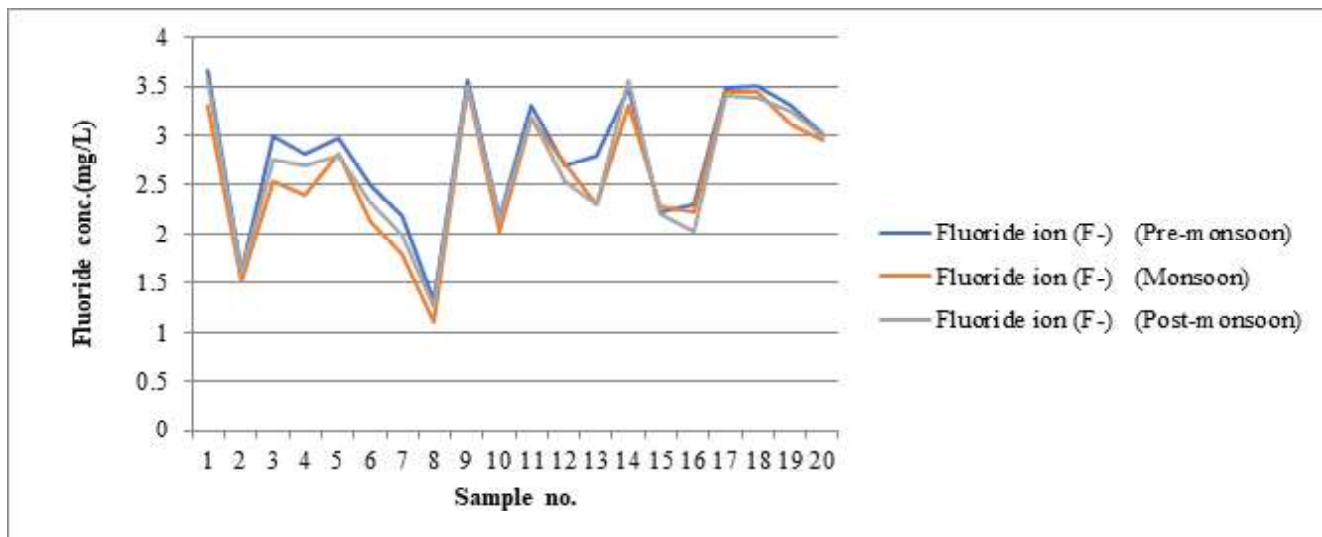
Research, Department of Chemistry, A.N. College, Patna.<sup>9,10</sup> Other physico-chemical parameters like pH, Electrical Conductivity, TDS, Total Hardness, Calcium Hardness, Magnesium Hardness, Alkalinity, Turbidity, Chloride, Sodium ion, Potassium ion, Sulphate and Iron were also analysed by the standard methods described by APHA and NEERI-2012.

**Study on health status of the people**

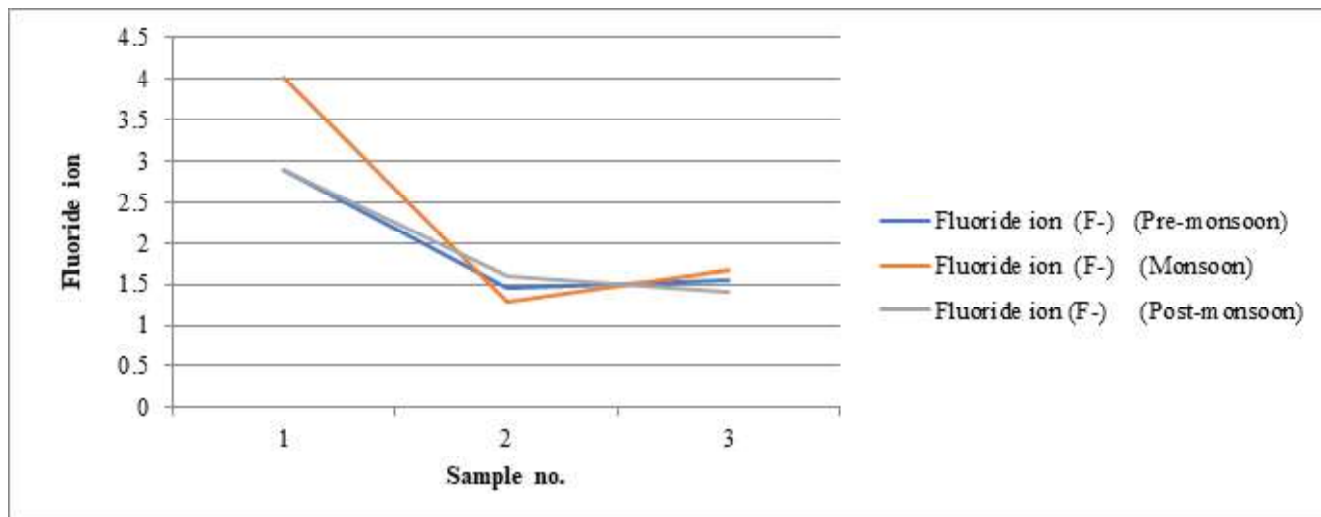
Health status survey was done in the affected villages. The health status survey included the study of their daily food intake and their Body Mass Index (BMI) values.<sup>11</sup> Most of the people had dental problems, some had muscular and joint pains. Very severe cases of bone deformity were found in the villages. The BMI was also found low in many of the villagers.



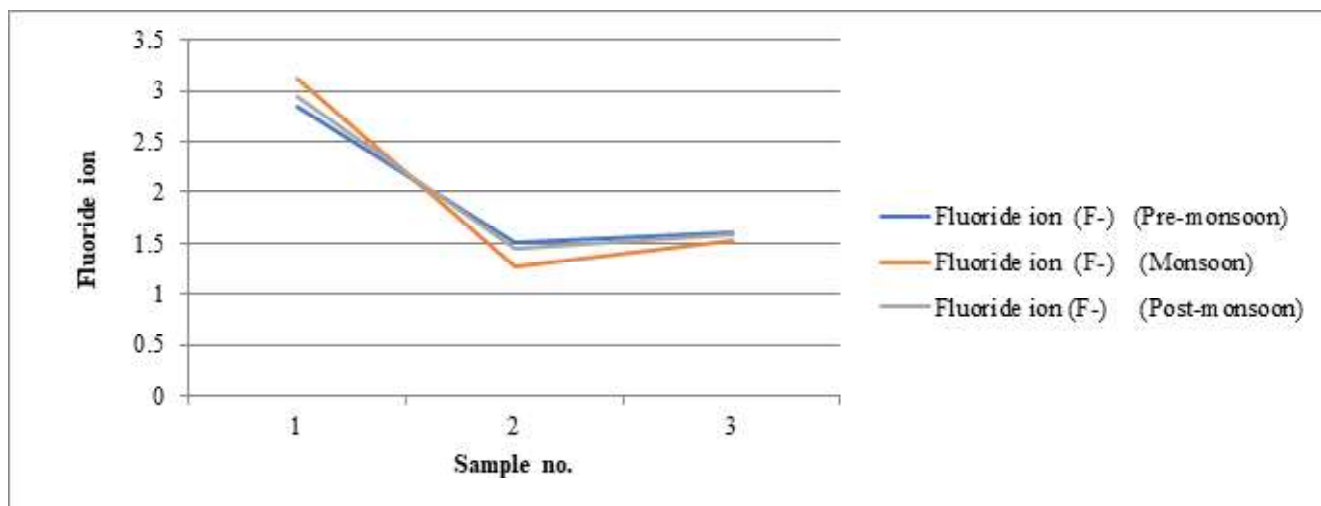
**Graph 1- Fluoride conc. in water samples of Hardia Sector D (2018)**



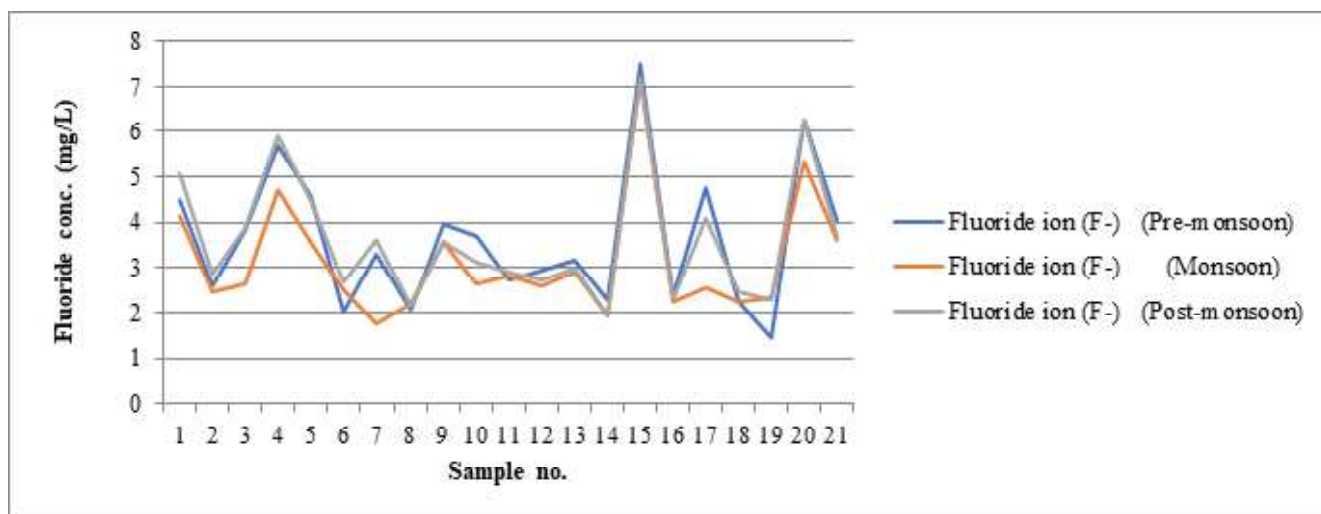
**Graph 2- Fluoride conc. in water samples of Hardia Sector D (2019)**



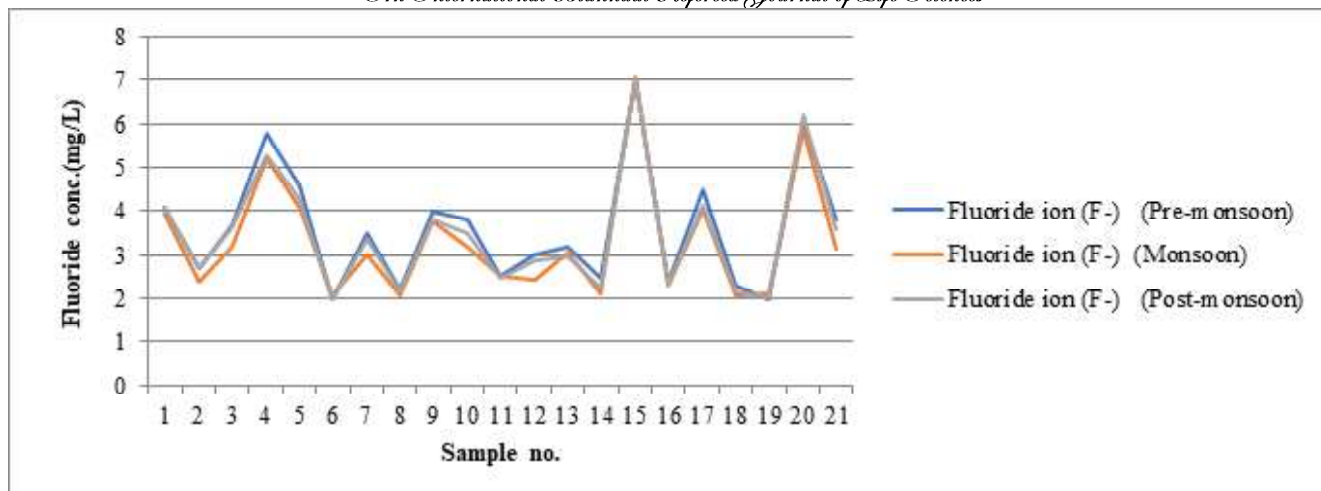
Graph 3- Fluoride ion conc. in water samples of Singar Khas and Hanuman Nagar (2018)



Graph 4- Fluoride ion conc. in water samples of Singar Khas and Hanuman Nagar (2019)



Graph 5- Fluoride conc. in water samples of Bhaunr (2018)



Graph 6- Fluoride conc. of water samples of Bhaunr (2019)

**RESULTS & DISCUSSION**

On testing the samples for fluoride it was found that maximum groundwater sources of the villages were contaminated with fluoride. Most of the groundwater sources had the fluoride level more than the permissible limit of 1.5 mg/L.

**Jajpur (Hardia Sector D)**

The groundwater sources in the village were contaminated with fluoride.

The peak value found was 3.65 mg/L which was during the pre-monsoon season of 2019. The inhabitants of that area reported the problems of joint pains, muscular pains and dental problems. All the three types of fluorosis are prevalent in that village. Few cases of knock-knee and few cases of bow legs were observed in the village. Inhabitants were also found to be suffering from non-skeletal fluorosis. Few people of the age group 15-40 years had abdominal or joint pains.

The BMI values of many inhabitants was found lower than 18. The intake of nutritious food by the villagers was very poor.



Fig 1. Skeletal Fluorosis cases in Hardia Sector D

**Hanuman Nagar and Singar Khas**

The groundwater sources in these villages were contaminated with fluoride.

The peak value found was 4.02 mg/L which was during the monsoon period of 2018. More than half of the inhabitants surveyed reported the problems of dental fluorosis. A few severe cases of dental fluorosis were also seen. Severe cases were also seen in children. Very few cases of skeletal fluorosis affected people were found in the village. There were no cases of knock-knee found. However few cases of people with bow legs were found in the villages. Maximum villagers above 40 years of age had the problem of joint and abdominal pains.

**Bhaunr**

Most of the groundwater sources in Bhaunr village were highly contaminated with fluoride.

Out of the 21 sources tested almost all the drinking water sources showed the presence of fluoride above the permissible limit. In one of the groundwater sources the concentration of fluoride was as high as 7.51 mg/L which

is much higher than the maximum permissible limit of 1.5 mg/L.

The fluoride concentration in most sources showed the peak value during the pre-monsoon period and minimum during the monsoon period. The inhabitants of that area reported the problems of joint pains, muscular pains and dental problems. Maximum people were normal and had no bone deformities. Except a few bow leg cases, no other inhabitants had skeletal problems. Since most of the people get sufficient nutrition, so the severity of the disease is less in this village as compared with the neighbouring villages where the severity of fluorosis is high due to lack of nutrition.

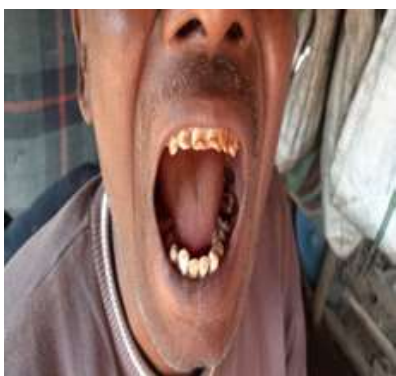


Fig 2. A case of Dental Fluorosis in Hanuman Nagar



Fig 3. A case of Dental Fluorosis in Bhaunr



Fig 4. A case of Skeletal Fluorosis in Bhaunr

## CONCLUSION

The present work confirms that the high concentration of fluoride in drinking water is responsible for the disease fluorosis in the four villages- Hardia Sector D, Singar Khas, Hanuman Nagar and Bhaunr. High level of fluoride is responsible for physical deformities among the inhabitants of the affected villages. The severity of fluorosis was higher where there was lack of sufficient nutrition.

## REFERENCES

1. **Thiry M. C. 2012.** Writ in Water. AATCC Review- American Association of Textile. *Chemists and Colorists*. **12(2):** 22.
2. **Liu D. H. & Lipták B. G. (Eds.). 1999.** Groundwater and surface water pollution. CRC Press.
3. **Setia R., Dhaliwal S. S., Kumar V., Singh R., Kukal S. S. & Pateriya B. 2020.** Impact assessment of metal contamination in surface water of Sutlej River (India) on human health risks. *Environmental Pollution*. **265:** 114907.
4. **Singh B. & Singh K. K. 2019.** Integrated Fluorosis Mitigation Programme For Abatement of Fluorosis in Selected Fluorosis Endemic Villages of Nawada District, Bihar. *Fluoride*. **52(1):** 82.
5. **Kumar Amrendra. 2009.** Groundwater Quality Assessment of Gaya District of Bihar with Special Reference to Fluoride Contamination and Health Hazards. Ph.D Thesis submitted to MU Bodh Gaya.12
6. **Kumar Nag A. 2016.** Physico-Chemical study of some Fluorosis affected Child Dental Caries and their BMI Value in Rajauli Sub-Division of Nawada District of Bihar. *Journal of Applicable Chemistry*. **5(4):** 816-825.
7. **Kumar P. & Singh A. K. 2021.** Study of fluorosis problems in Hardia Sector D (Jajpur Village) of Rajauli block of Nawada district, Bihar. *Biospectra*. **16(1):** 37-40.
8. **Singh A. K., Kumar P. & Patel V. 2021.** Groundwater fluoride contamination in Bhaunr Village of Rajauli Block of Nawada District, Bihar. *Biospectra*. **16(2):** 25-28.

**Biospectra : Vol. 18(1), March, 2023**

*An International Biannual Refereed Journal of Life Sciences*

9. **APHA. 2017.** Standard methods for examination of water and wastewater, Washington DC, USA (23<sup>rd</sup> Edition, 2017)
10. **Kumar A., Singh V. K., Singh K. K., Singh B., Nag A. K. 2016.** Physico-Chemical Study of Some Fluorosis Affected Child Dental Caries and Their BMI Value In Rajauli Sub-Division of Nawada District of Bihar. *Journal of Applicable Chemistry*. **5(4):** 816-825.
11. **Ersoy I. H., Koroglu B. K., Varol S., Ersoy S., Varol E., Aylak F., & Tamer M. N. 2011.** Serum copper, zinc, and magnesium levels in patients with chronic fluorosis. *Biological Trace Element Research*. **143:** 619-624.

\*\*\*