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### Endemic Survey of Fluorosis in Prakasam District area: A Report

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#### Abstract

In recent, the people in endemic regions in India are suffering from fluorosis. It is known that fluorosis might be due to consumption of drinking water containing high levels of fluoride. Ten water samples were collected from dug well and bore well in every village and used for analyzing fluoride concentration (ppm) in both Bommireddy palli and Kasipuram villages in Prakasam District of Andhra Pradesh, India. Additionally, we are collected data from 200 (100 male and 100 female) people in each village for determine skeletal and dental fluorosis. Fluoride concentrations in surface and ground water samples of these villages are having 7.6 to 8.2 ppm and 5.8 to 7.4 ppm. The present survey on Fluorosis in prakasam district revealed that higher incidence, severity of skeletal manifestation and dental fluorosis in both males and female. In addition, the results suggested that 60% of the people in Bommireddy palli and Kasipuram in Prakasam district are suffering from skeletal fluorosis and dental Fluorosis and children are suffering from stunted growth.

Key-Words: Fluoride, Dental fluorosis, skeletal fluorosis, Bommireddy palli, Kasipuram, Prakasam district

#### Introduction

Fluoride is abundantly available on our planet and occupied 13<sup>th</sup> place<sup>1</sup>. Fluoride ions in optimum concentrations are helpful for health, if higher concentrations affect health. The drinking water quality guideline value for fluoride is 1.5 mg/l, described by the World Health Organization and Indian Council of Medical Research<sup>2,3</sup>. Endemic fluorosis is related to higher concentration of fluoride in water. Although, 65% of Fluorosis is dispersed in 25 countries around the world such as India, Africa, China, Japan, New Zealand, Australia, Israel, certain parts of Thailand<sup>4</sup>. Endemic fluorosis is an important public health problem in India. In India, extreme fluoride problem in drinking water was first reported in 1937 in the state of Andhra Pradesh<sup>5</sup>. Recently, several researchers have been reported that twenty five million people in nineteen states and union territories have already been affected due to fluorosis<sup>6,7</sup>. However, in Andhra Pradesh seventeen districts are affected by fluorosis. Among them Prakasham district is the second-most severely affected district<sup>8</sup>. Prakasam district in Andhra pradesh is affected by endemic fluorosis and many villages in the district are identified as endemic fluorosis areas<sup>9</sup>.

Fluoride concentrations in drinking and ground water samples in Prakasam district varied between 0.5 and 9.0 mg/L<sup>8</sup>. Additionally, Li et al.<sup>10</sup> have been carried out a study to determine the relation of influence of fluoride between environmental and biological systems, but there is a great deal of controversy regarding its potential genotoxic effects in mammals.

It is well known that fluoride ions enter in to the body through various routs such as drinking water, food, industrial exposure, drugs, cosmetics, tea, beverages, tobacco, and edible marine animals<sup>11</sup>. In daily life, 75% of fluoride enters into the body only through drinking water and absorbed from small intestine<sup>12,13</sup>. Fluoride has strong electronegativity due to this property fluoride ions attracted to positively charged calcium ions in teeth and bones. It is well established, that fluoride caused for dental fluorosis, teeth mottling, skeletal fluorosis and deformation of bones in children as well as adults<sup>14</sup>. Though, excess amount of fluoride interfere with carbohydrates, lipids, protein, vitamins, enzymes and mineral metabolism. However, a high level of fluoride intake is responsible for skeletal deformation and weakening of joints<sup>15</sup> (WHO, 1985).

Several researchers have been revealed that sodium fluoride has anticholinesterase and anticurare responsible for effects on muscle and nerve. Thus, sodium fluoride has been shown no effect on normal muscle membrane potentials<sup>16</sup>. Both skeletal fluorosis

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and dental fluorosis are separated by a prolonged relatively symptom-free interval of 10-30 years during which time the skeleton does not stop accumulating fluoride though non-skeletal symptoms such as gastrointestinal may be present. In the advanced stages, skeletal fluorosis causes crippling deformities and neurological complications, such as radiculomyelopathy, osteophytosis, sclerosed vertebral column and ossified ligaments leads to vascular compromise and ischemic injury of spinal cord and spinal roots<sup>17</sup>. Enamel hypoplasia occurs during the formative stage of tooth development by consuming extreme levels of fluoride, leads to defective enamel formation<sup>18</sup>. Dental fluorosis starts as chalky white spots, later turns to brown. Clinical symptoms are thin white lines on the enamel to chalky and opaque enamel<sup>19,20</sup>.

In the present study, the data pertaining to fluoride concentrations in the dug well and bore well water in Bommireddy palli and Kasipuram of Prakasham district in Andhra Pradesh state of India has been presented. For this study, field samples from two villages were collected and analyzed. In this paper, the obtained results are presented and discussed on skeletal fluorosis resulted in crippled limbs and dental fluorosis of the two villages in Prakasam district.

### Material and Methods

#### Study area

The two villages (Bommireddy palli and Kasipuram), are selected for the present study have rock black and red soils agriculture lands. The temperature in these areas is rising up to 43<sup>0</sup>c in summer and between 18<sup>0</sup>c to 20<sup>0</sup>c in winter. The studied area location map is shown in Figure 1. The people lived in the two villages are

### Results and Discussion

The main source of drinking water in two villages is coming from bore wells and dug wells. The present survey is conducted to know the concentration of fluoride level in water in dug well and bore well and total incidence of skeletal and dental fluorosis in both males and females of the two villages, such as Bommireddy palli and Kasipuram.

The results of present study are described fluoride content in Bommireddy palli village is 8.2 ppm (Table.1). The analytical data revealed that the groundwater in the study areas is alkaline. The conducted epidemiological survey is revealed that 65 males (out of 100 males) and 52 females (out of 100 females) are affected with skeletal fluorosis in Bommireddy palli. The prevalence of skeletal fluorosis in both male and female is 58.5% (Table 2). Besides, out of 100 male and female 73 males and 68 females are affected with dental fluorosis. The total percentage

manual labors in rocky fields and residing from 4 decades in these villages. The yielding of crops in these villages in very poor due to unfertile soil and so the people are bending fed with low nutritive diet. The villages used to chew Betel nut powder and tobacco leaves etc.

### Methodology

The population in two villages is above 400 and the survey made on sampling method. The samples were collected from bore wells as well as dug wells which are extensively used for drinking and other domestic purposes. The collected groundwater samples were used for estimation of fluoride concentration using a fluoride specific elector methods<sup>21</sup>. The data were collected from 200 people in each village (100 males and 100 females) and used to determine the incidence of skeletal and dental fluorosis in male and females of two villages.

### Estimation of Fluoride Concentration

Water samples were collected in good quality polythene bottles of one liter capacity and brought to the laboratory with out adding any preservatives. To avoid contamination, the samples were collected directly in rinsed bottles. The samples were determined with fluoride ion electrode (IRION) and IRION 407A ion meter for estimation of fluoride concentration. A 25ml of aliquot was taken in polythene beaker and 25ml of TISAB – III (Total ionic strength adjuster buffer, IRION Application Solution) was added<sup>21</sup>. Ion meter was standardized against solution of known fluoride concentration in the standard sample and read directly on the meter scale. The scale was calibrated in ppm of fluoride concentration in water.

of dental fluorosis is 70.5% in both male and females (Table. 2). The figure 2 has shown the skeletal and dental fluorosis in Bommireddy palli. From the Table 2, it is evident that the total incidence of fluorosis 69% in males, and 60% in females (both dental and skeletal fluorosis) in Bommireddy palli village.

Similarly, Table 1 has been shown the results of fluoride analysis of dug and bore well water samples collected from Kasipuram village. The data indicate that fluoride concentration is 7.4 ppm in water in both bore well and dug well. The results place in Table 3 are described that 61 males and 39 females (out of 100 males and females) are affected with skeletal fluorosis. The occurrence of skeletal fluorosis (both male and female) in Kasipuram is 50%. Moreover, 66 males and 52 females are affected with dental fluorosis. The total percentage of dental fluorosis is 59% in both men and women in kasipuram (Table. 3). Skeletal and dental fluorosis in kasipuram has shown in Figure 3.

However, the total incidence of fluorosis is 63.5% in males and 51.5% in females (both dental and skeletal fluorosis) in Kasipuram village (Table. 3).

The current study is discovered for the first time, two remote villages of Prakasam district such as Bommireddy palli and Kasipuram which have high fluoride in drinking water. The drinking water samples of these villages contain 8.2 and 7.4 ppm. In Prakasam district, the reason for the contamination of fluoride in drinking water is due to geological origin, as there are no fluoride contaminating industries are located in this region or nearby. Supply of safe drinking water to these villages is a fruitful way to minimize fluorosis. People of all age groups in these regions are exposed to more fluoride, particularly infants.

It was stated in 1993 that crippling skeletal fluorosis might occur in people who have ingested higher levels of fluoride<sup>22</sup>. The prevalence of skeletal fluorosis in people (both men and women) of Bommireddy palli and Kasipuram villages is 58.5% and 50%. Similar to our results, elevated levels of fluoride in both dug well and bore well waters is caused to skeletal fluorosis<sup>23, 24</sup>. Skeletal fluorosis is usually not recognized in early stages until the disease reaches an advanced stage<sup>25</sup>. It is believed that early stages of skeletal fluorosis start with pain in bones and joints, muscle weakness, sporadic pain, stiffness of joints and chronic fatigue. During later stages, calcification of the bones takes place, osteoporosis in long bones, and bones become denser and develop abnormal crystalline structure. In the advanced stage the bones and joints become completely weak and moving them is difficult<sup>26</sup>. Additionally, the vertebrae in the spine fuse together and the patient is left crippled which is the final stage. Shashi et al,<sup>27</sup> has been suggested that the normal persons exposed to 0.6-1.0 ppm drinking water fluoride caused chromosomal aberration in endemic areas. However, general skeletal fluorosis directly affects the economy of villagers as it causes illness and debilitation not only in humans but, also in their domestic animals, on which they depend for their basic income<sup>28</sup>.

The present study has been proven, that 60% of people in the two villages suffering from dental fluorosis. A number of the other recent investigations indicating, that the prevalence of dental fluorosis increases with increase in fluoride concentration in drinking water<sup>29, 30</sup>. Our results are in consonance with results of Hanumantharao et al.<sup>23</sup>. Although, the prevalence of dental fluorosis might be vary widely between different geographical locations having almost same fluoride concentrations in drinking water. These findings

demonstrated that, besides water fluoride concentration and duration of exposure, other factors such as dissolve salts in water, nutrition, and habits also affect the incidence of dental fluorosis.

### Conclusion

A high prevalence of skeletal fluorosis and dental fluorosis exists in Bommireddy palli and Kasipuram. There was an increase in severity of skeletal and dental fluorosis in subjects as the fluoride concentration increased in drinking water. The study established the relationship between the prevalence of skeletal and dental fluorosis and gender of the subjects. Skeletal fluorosis leads to impairment, disability and subsequently makes the affected subject handicap. Therefore, they are unable to get employment or labor for their daily livelihood, lead their life as dependents on others. However, the skeletal and dental fluorosis is affected youth and have extremely difficult situation, where they were unable to find alliance from non-fluoride affected villages, thus they are forced to marry the youth from the same or fluoride affected villages. Hence, we suggested immediate action by the government is needed to save the people of Bommireddy palli and Kasipuram villages from skeletal and dental fluorosis.

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**Table 1: Fluoride content in drinking water of two villages (in ppm)**

| Name of the Village     | Source or Water | Fluoride content (ppm) | Mean |
|-------------------------|-----------------|------------------------|------|
| <b>Bommireddy Palli</b> | Borewell – I    | 7.6                    | 8.2  |
|                         | Borewell – II   | 8.9                    |      |
|                         | Borewell – III  | 6.8                    |      |
|                         | Dugwell – I     | 9.6                    |      |
|                         | Dugwell – II    | 8.7                    |      |
|                         | Dugwell – III   | 7.9                    |      |
| <b>Kasi puram</b>       | Borewell – I    | 5.8                    | 7.4  |
|                         | Borewell – II   | 6.4                    |      |
|                         | Borewell – III  | 7.5                    |      |
|                         | Dugwell – I     | 8.9                    |      |
|                         | Dugwell – II    | 7.8                    |      |
|                         | Dugwell – III   | 8.5                    |      |

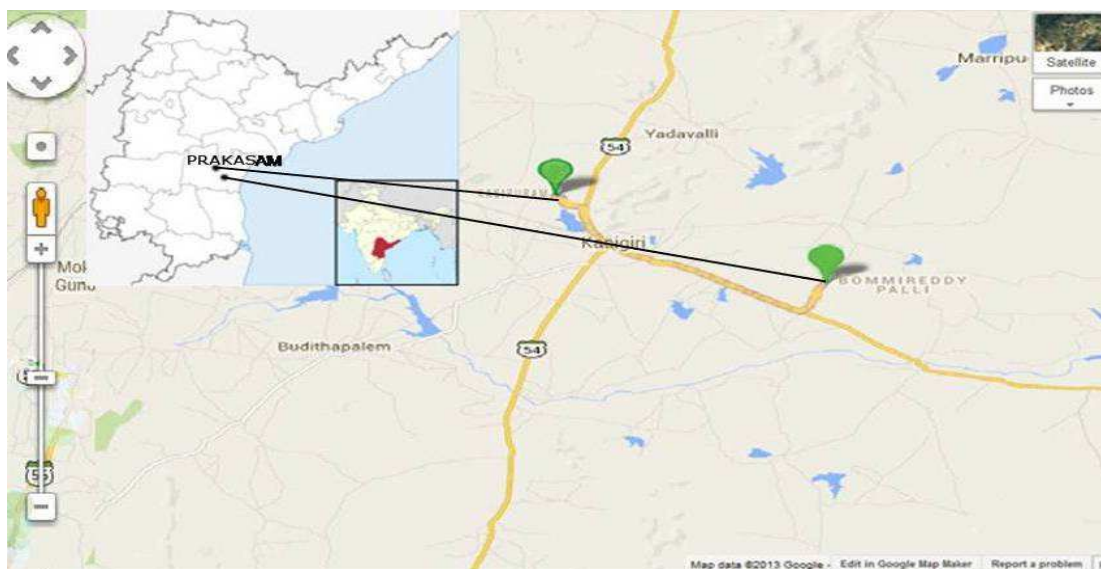
Number of studied water sample = 10

**Table 2: Total incidence of fluorosis is including gender distribution in the Bommireddy palli village**

| Gender        | Total number surveyed | Affected with Dental Fluorosis | Affected with Skeletal Fluorosis | Total incidence of Fluorosis |
|---------------|-----------------------|--------------------------------|----------------------------------|------------------------------|
| <b>Male</b>   | 100                   | 73                             | 65                               | 69%                          |
| <b>Female</b> | 100                   | 68                             | 52                               | 60%                          |
| <b>Total</b>  | 200                   | 70.5%(141)                     | 58.5%(117)                       |                              |

**Table 3: Total incidence of fluorosis is including gender distribution in the Kasipuram village**

| Gender        | Total number surveyed | Affected with Dental Fluorosis | Affected with Skeletal Fluorosis | Total incidence of Fluorosis |
|---------------|-----------------------|--------------------------------|----------------------------------|------------------------------|
| <b>Male</b>   | 100                   | 66                             | 61                               | 63.5%                        |
| <b>Female</b> | 100                   | 52                             | 39                               | 51.5%                        |
| <b>Total</b>  | 200                   | 59%(118)                       | 50%(100)                         |                              |



**Fig. 1: Location map of areas are studied**



Fig. 2: Skeletal and Dental fluorosis in Bommireddy palli of Prakasam District  
Fig. 3: Skeletal and Dental fluorosis in Kasipuram of Prakasam District

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