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FLUORIDE CONTAMINATION OF GROUND WATER AND ITS HARMFUL EFFECTS ON THE HUMAN POPULATION IN KANPUR CITY

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Abstract: Ground water is the chief source of freshwater on earth. In India, around 20 to 25% of the population is fluoride affected, especially in rural areas, but in the city there are adverse effects of fluoride in the human beings. Drinking water with an excessive amount of fluoride causes fluorosis disease. It badly affects people of all age groups, especially children and old citizens. According to an estimation, fluoride beyond the desirable amount [0.5 to 1.5 mg/lit.] in ground water is a serious problem in many parts of India, but in the Kanpur region of Uttar Pradesh, people are badly affected by fluoride's effects. Fluoride is the electronegative element and it belongs to the halogen group of minerals. Fluoride enters our body through water, food, drugs, cosmetics material etc. World health organization [W.H.O.] recommends that the ideal range of fluoride contents in drinking water should be 1.0 to 1.5 ppm. Fluoride concentrations beyond the standard limits causes dental and skeletal fluorosis. Toxicity of fluoride also causes some non-skeletal diseases like pain in the joints, muscle weakness, fatigue, anemia with low hemoglobin levels, etc in human beings. Nowadays, the release of environmental pollutants through industrial and agricultural usage affects the environment badly. In the present study, it is observed that some areas in Kanpur have higher quality of fluoride in groundwater. Additionally it is also concluded and analyzed that the content of fluoride in groundwater is higher in comparison to the standards as prescribed by the W.H.O.This paper also presents a review, which focuses on the sources of fluoride in groundwater, its impacts on health and different control measures.

Keywords: *Dental fluorosis, World Health Organization [W.H.O] Skeletal fluorosis, Low Hemoglobin Levels, Contamination of Groundwater.*

INTRODUCTION

The fluorides belong to the halogen group of minerals and are natural constituents of the environment. Fluoride is the most electronegative of all chemical elements and is never encountered in nature in the element form. It represents about 0.06% to 0.09% of the earth's crust. (Wedepohl, 1974). Ground water containing dissolved ions beyond the permissible limits is very harmful and is not suitable for drinking and domestic purposes. Fluoride beyond a desirable amount (0.7 to 1.5 mg/Lit) in ground water is a very serious problem in several parts of the world especially in India. (Brindha et al, 2010). Fluoride has been described as an essential nutrient and it has been included in the list of 14 elements recognized to be physiologically essential for the growth and normal development of human being (Whitford, 1996) In natural forms, the fluoride ions come from the element, fluorine. Fluorine is the 17th most abundant element in the earth's crust and never occurs in a free state in nature. Fluoride exists only in combination with other elements as fluoride compounds, which are constituents of minerals in rocks and soil. (Edmunds and Smedley, 2003).

At low concentrations it is proved that fluoride deficiencies can cause many problems but at high fluoride concentrations other deleterious effects are bad. According to (Venkata et al, 1995), the overdose of fluoride in drinking water is very harmful and can affect bone and teeth structure i.e., the permissible limit is (<0.5 mg/l or > 1.5 mg/l). Among the water quality parameters, fluoride ions exhibit unique properties as its concentration in optimum dose in drinking water is advantageous to health and if the concentration exceeds the limit, it affects the health (Edmonds and Snedley, 1996).

VARIOUS SOURCES OF FLUORIDE

[A] WATER FLUORIDATION

Based on recent researches, the US Public Health Service (USPHS, 1986) established the optimum concentration for fluoride in the water of the United States in the range of 0.7 – 1.2 ppm. This range effectively reduces tooth decay while minimizing the occurrence of dental fluorosis. The optimum level is totally dependent on the annual average of the maximum daily air temperature recorded in the particular geographic area.

[B] FLUORIDE FROM THE AIR

In the atmosphere, the concentration of airborne fluoride ions is not present. Studies report that the levels of fluoride in the air contribute a very little amount to an individual's overall fluoride intake. (Hodge and Smith, 1977)

[C] FLUORIDE IN FOOD INGESTED

Some fishes, such as Sardines may contain higher amounts of fluoride intake. Another source of fluoride is Brewed tea. The brewed tea contains fluoride concentrations of 1-6 ppm depending on the amount of tea used, the water fluoride concentration and the brewing time.

In an estimation, the average dietary intake of fluoride by a body of a child, residing in optimally fluoridated communities is 0.05 mg/kg/day; in communities without optimally fluoridated water, the average intake of children is 50% lower comparatively. Dietary fluoride intake by adults in optimally fluoridated (1 ppm) areas is (1.5 – 3.5 mg/day), and in non fluoridated areas, the average is (0.2 – 1.0 mg/day) (Evaluation and dietary reference intakes: Washington).

PRESENT SITUATION OF FLUORIDE LEVEL IN INDIAN GROUND WATER

In India, fluoride level in ground water varies in different regions depending upon the geographical situation and strata of the water level.

High concentrations of fluoride (<1.5mg/l) have been recorded in the states of Delhi, Rajasthan, Haryana, Karnataka, Maharashtra, Gujarat , Uttar Pradesh and some other states of India (Susheela,2001).

Due to the lack of central water supply in most of the countries, groundwater is being used for drinking purposes. Fluoride levels in drinking water are also found to be low or normal in certain areas. Unfortunately, due to the bad management, proper fluoride mapping has not been carried and is not successful in India. Dietary fluoride supplements are available only by prescription and are intended for use for children living in non fluoridated areas. This can increase their fluoride exposure in comparison to the children living in optimally fluoridated areas (Largenet, 1970). Dietary fluoride supplements are available in two forms. Drops for infants aged upto six months and chewable tablets for growing children and adolescents (A.D.A.C. 1995).

PREVALENCE OF FLUOROSIS

There are 23 nations and India is also under the range of a large population that suffers from dental and skeletal fluorosis due to large contamination of ground water containing fluoride (UNICEF, 1999). India has acute public health problems induced by utilization of ground water as a source of drinking water. Fluorosis was first detected in India among cattle and humans in the state of Andhra Pradesh (Subba, R.N. 2008).

In India, approximately 65-75 million people drink groundwater which is contaminated with fluoride and the number affected by fluorosis disease is estimated at 3.5 to 5.5 million. Especially in children,

the disease fluorosis is very common (Athavale and Das, 1999). In India, the prominent states, which are severely affected by fluorosis are Gujarat, Rajasthan, Andhra Pradesh, Tamilnadu, and Uttar Pradesh (Muralidharan et al,2002).

EFFECT OF GROUND WATER FLUORIDE ON HUMAN HEALTH

[A] ENDOCRINE EFFECT.

The main endocrine's effects of fluoride exposures in experimental animals and in humans include decreased thyroid function, increased parathyroid hormone activity, calcitonin activity, secondary hyperparathyroidism , and effects on timing of sexual maturity. Some of these effects are related with fluoride intake that is taken in regular basis on fluoride concentration in drinking water of 4 mg/Lit especially for young children and for individuals with high water intake, (Apambire, et.al, 1997)

[B] EFFECTS ON OTHER ORGAN SYSTEMS:

The modern researches prove that over use of fluoride contents affect the gastro-intestinal system, kidney, liver, and the immune system. Several case reports in vitro and animal studies indicate that exposure to fluoride at concentrations greater than 4 mg/lit can be irritating to the gastrointestinal system, and affect the renal tissues. Their function also alters some immunologic and hepatic parameters.

[C] DENTAL FLUOROSIS AND SKELETAL FLUOROSIS

Fluoride is among the substances for which there are lower (0.6 Mg/lit) and upper (1.2 mg/lit) limits of concentration in drinking water, which causes identified health effects and benefits for human beings. Very low doses of fluoride (<0.6 mg/lit) in water causes tooth decay. But when consumed in higher doses (> 1.5 mg/lit), it leads to dental fluorosis and very excessively high concentration (>3.0 mg/lit) of fluoride may lead to skeletal fluorosis. High manifestations of dental fluorosis are mostly found in children upto the age of 12 years and skeletal fluorosis may occur when fluoride concentrations in drinking water exceed 4-7 mg/lit. The high fluoride concentration in bone density leads to the thickness of limb bones and calcification of ligaments (Teotia and Teotia, 1988).The quantity of fluoride accumulation by the skeleton is closely related to the concentration of fluoride in drinking water from the ground and normal levels of fluoride in the regular diet. Numerous studies have established that fluoride is bound with the bone replacing hydroxyl or bicarbonate groups. They are generally associated with hydroxyapatite structure and increase the crystallinity of apatite. The term dental fluorosis is described as a diffuse symmetric hypomineralization disorder of ameloblasts. Fluorosis is irreversible and only occurs with exposure to fluoride when enamel is developing. Instead of being a normal creamy white translucent color, fluorosed enamel is porous and opaque. Teeth can resemble a white chalk colour with cloudy striated enamel. White specks showing "snow-capping" yellowish-brown spots and brown pits on teeth are the main characteristics of fluorosis. Fluorosis is a toxic manifestation of chronic (low-dose, long-term) fluoride intake. The most critical period to avoid fluoride exposure are the first three to six years of a child's life.

DISCUSSION AND CONCLUSION

In India, about 62 million people including 6.5 million children suffer from fluorosis, because of fluoride contaminated water. The chronic fluoride toxicity depends upon the actual amount of fluoride ingested per day and the duration of exposure to high fluoride intake through drinking water from ground (Arif et,al,2011). Rock minerals and waste disposal contributes to fluoride contamination in groundwater. Researchers have observed in different areas of the Kanpur region that different concentrations of fluoride contamination are responsible for an affected area. The provisions of safe, low fluoride water from alternative sources should be investigated.Various methods should be developed for the defluoridation of water that can be used to prevent fluoride contamination. Ground

water of a particular area should be thoroughly studied before its use for domestic purposes and treated accordingly. A suitable method can be chosen for the treatment of fluoride contamination. Ground water containing a higher range of fluoride ions is very harmful for drinking and domestic purposes and not suitable for health In the present study, a comparison was observed, which shows various ground water strata and fluoride concentration in the ground water and their relationship in the health. The fluoride concentration is low, when the water level rises due to dilution by fresh rain water recharge. Leaching of fluoride bearing minerals and minerals of rocks are the two main reasons which cause elevated concentrations of fluoride in groundwater. Fluorosis is the most common disease in Kanpur, caused by consumption of excess amounts of fluoride in drinking water. In the village areas, deep borewells carry excess amounts of fluoride causing various diseases in children in a particular area. The quality of ground water should be thoroughly studied before its use and various preventive methods should be chosen against disease prevention. The problem of sewage in many parts of Uttar Pradesh especially in Kanpur needs attention from the government. For the prevention, defluorination of ground water should be treated before domestic use. This needs to be practiced to improve the quality of groundwater in the selected areas of the city. It is very clear and evident that fluoride in recommended concentration is beneficial for health. A judicious use of fluoride is required and is mandatory. For prevention against fluorosis it is necessary to work on selected areas with low and high levels of fluoride. An ideal value of fluoride as recommended by the government should be added in the drinking water (Misra and Misra, 2018). For achieving optimal health reversal preventive measures should be taken to use fluoride.

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