



A Review On Effects Of Fluoride On Human Health In Rajasthan

Ranjeeta Soni

Jagannath University, Jaipur, India

Dr. Shikha Modi

Jagannath University, Jaipur, India

Abstract:

Water is a major source of fluoride intake .Fluoride is beneficial to health if the concentration of the fluoride ion (CF) in drinking water is less than 1.5 mg/L (WHO 1994).A higher concentration causes serious health hazards. The disease caused manifests itself in three forms, namely, dental, skeletal, and non-skeletal fluorosis. Dental fluorosis produces widespread brown stains on teeth and may cause pitting. Skeletal fluorosis causes crippling and severe pain and stiffness of the backbone and joints (Bulusu and Nawlakhe, 1992). In Rajasthan, 18 out of 32 districts are suffered from fluorosis diseases.

Key words: *Fluorosis, Dental, Skeletal, Non-Skeletal, health.*

1.Introduction

Fluoride is frequently encountered in minerals and in geochemical deposits and is generally released into subsoil water sources by slow natural degradation of fluorine contained in rocks. Fluorine is an important element for human beings, as it helps in growth and prevents the enamel of the teeth from dissolving under acidic conditions. Various dietary components influence the absorption of fluorides from gastrointestinal tract and the absorbed fluorides are distributed throughout the body. Drinking water and sea food are good sources of fluoride.

2.Fluoride At World Level

The latest information shows that fluorosis is endemic in at least 25 countries across the world. The total number of people affected is not known, but a conservative estimate would number in the tens of millions. So the high concentrations of fluoride occurring naturally in groundwater and coal have caused widespread fluorosis - a serious bone disease - among local populations. A range of everyday products, notably toothpaste and drinking water, the fluoride in small doses has no adverse effects on health to offset its proven benefits in preventing dental decay. But more and more scientists are now seriously questioning the benefits of fluoride, even in small amounts. Since some fluoride compounds in the earth's upper crust are soluble in water, fluoride is found in both surface waters and groundwater. In surface freshwater, however, fluoride concentrations are usually low - 0.01 ppm to 0.3 ppm.

In groundwater, the natural concentration of fluoride depends on the geological, chemical and physical characteristics of the aquifer, the porosity and acidity of the soil and rocks, the temperature, the action of other chemical elements, and the depth of wells. Because of the large number of variables, the fluoride concentrations in groundwater can range from well under 1 ppm to more than 35 ppm. In India, a concentration up to 38.5 ppm has been reported in drinking water.

3.Fluoride In India

India is among the many countries in the world where About 62 million people including 6 million children are affected with dental, skeletal and non-skeletal fluorosis .The states of Andhra Pradesh, Bihar, Chhattisgarh, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal are affected by fluoride contamination in water. This involves about 9000 villages affecting

30 million people (Nawalakhe and Paramasivam, 1993). It must be noted that the problem of excess fluoride in drinking water is of recent origin in most parts. Digging up of shallow aquifers for irrigation has resulted in declining levels of ground water. As a result, deeper aquifers are used, and the water in these aquifers contains a higher level of fluoride (Gupta and Sharma, 1995).

4. Fluoride In Rajasthan

In Rajasthan, 18 out of 32 districts are fluorotic and 11 millions of the populations are at risk. In the absence of perennial rivers, surface and canal system, groundwater remains the main source of drinking water. It contains 2 to 20 mg/L of fluoride. Fluoride is more common in ground water than in surface water. The main sources of fluoride in ground water are different fluoride bearing rocks. Fluoride ions are important in water supplies because of their peculiar characteristics. They cannot be tolerated in too or low or too high concentration. A Fluoride concentration of approximately 0.5mg/l to 1mg/l in drinking water effectively reduces dental caries or tooth decay without any harmful effects on health. Excess concentration of fluoride (more than 2mg/l) causes dental fluorosis (disfigurement of the teeth) and harm to bony structures.

In Rajasthan the existence of fluorides was first detected in 1964 when a survey was under taken by state PHED in collaboration with NEERI on the basis of reports of some peculiar diseases. Some villages were mainly in Nagour, Jaipur and Jhunjhnu district were traced later as endemic for fluorosis. The concentration in ground water varied from as low as zero to 18.00ppm as maximum. Hence it becomes more necessary to fluoride concentration, exactly and maintains it in between 0.5mg/l to 1.5mg/l in water.

5. General Facts Related With Fluoride

According to 1984 guidelines published by the World Health Organization (WHO) fluoride is an effective agent for preventing dental caries if taken in 'optimal' amounts. But a single 'optimal' level for daily intake cannot be agreed because the nutritional status of individuals, which varies greatly, influences the rate at which fluoride is absorbed by the body. A diet poor in calcium, for example, increases the body's retention of fluoride.

In many countries, fluoride is purposely added to the water supply, toothpaste and sometimes other products to promote dental health. It should be noted that fluoride is also found in some foodstuffs and in the air (mostly from production of phosphate

fertilizers or burning of fluoride-containing fuels), so the amount of fluoride people actually ingest may be higher than assumed.

6. Fluoride: Good Or Bad For Health

Fluoride was first used to fight dental cavities in the 1940s, its effectiveness defended on two grounds:

- Fluoride inhibits enzymes that breed acid-producing oral bacteria whose acid eats away tooth enamel. This observation is valid, but some scientists now believe that the harmful impact of fluoride on other useful enzymes far outweighs the beneficial effect on caries prevention.
- Fluoride ions bind with calcium ions, strengthening tooth enamel as it forms in children. Many researchers now consider this more of an assumption than fact, because of conflicting evidence from studies in India and several other countries over the past 10 to 15 years. Nevertheless, agreement is universal that excessive fluoride intake leads to loss of calcium from the tooth matrix, aggravating cavity formation throughout life rather than remedying it, and so causing dental fluorosis. Severe, chronic and cumulative overexposure can cause the incurable crippling of skeletal fluorosis.

7. Symptoms Of Fluorosis

Dental fluorosis, which is characterized by discolored, blackened, mottled or chalky-white teeth, is a clear indication of overexposure to fluoride during childhood when the teeth were developing. These effects are not apparent if the teeth were already fully grown prior to the fluoride overexposure; therefore, the fact that an adult may show no signs of dental fluorosis does not necessarily mean that his or her fluoride intake is within the safety limit.

Chronic intake of excessive fluoride can lead to the severe and permanent bone and joint deformations of skeletal fluorosis. Early symptoms include sporadic pain and stiffness of joints: headache, stomach-ache and muscle weakness can also be warning signs. The next stage is osteosclerosis (hardening and calcifying of the bones), and finally the spine, major joints, muscles and nervous system are damaged.

Whether dental or skeletal, fluorosis is irreversible and no treatment exists. The only remedy is prevention, by keeping fluoride intake within safe limits.

8. Various Health Impacts Of Fluoride

Fluoride inhibits enzymes that breed acid-producing oral bacteria whose acid eats away tooth enamel. This observation is valid, but some scientists now believe that the harmful impact of fluoride on other useful enzymes far outweighs the beneficial effect on caries prevention.

□ Fluoride ions bind with calcium ions, strengthening tooth enamel as it forms in children.

Many researchers now consider this more of an assumption than fact, because of conflicting evidence from studies in India and several other countries over the past 10 to 15 years. Nevertheless, agreement is universal that excessive fluoride intake leads to loss of calcium from the tooth matrix, aggravating cavity formation throughout life rather than remedying it, and so causing dental fluorosis. Severe, chronic and cumulative overexposure can cause the incurable crippling of skeletal fluorosis. Fluoride being an electronegative element and having a negative charge is attracted by positively charged ions like calcium (Ca^{++}). Bone and tooth having highest amount of calcium in the body attracts the maximum amount of fluoride and is deposited as Calcium Fluoroapatite crystals. Intake of fluoride above 1.5 mg/L may lead to serious manifestations;

9. Dental Fluorosis

Incidences of mottled teeth have been observed even with range of 0.7 – 1.5 mg F / l in drinking water. The minimal daily intake of fluoride that can cause very mild or mild fluorosis is estimated to be about 0.1 mg/kg body weight. Dental fluorosis is the loss of luster and shine of the dental enamel. The discoloration starts from white yellow, brown to black. (Discoloration is either as spots or horizontal streaks). Enamel matrix is laid down on incremental lines before and after birth. Hence dental fluorosis is invariably seen on horizontal lines or on bands on the surface of the teeth. Fluorosis is seen as mild moderate and severe depending on the amount of fluoride ingested during the stages of formation of the teeth.

Teeth commonly affected by fluorosis are central incisors, lateral incisors and the molars of the permanent dentition. It affects both the inner and the outer surfaces of teeth. The symptoms of dental fluorosis are as given below:

Dullness of the teeth and loss of shine with developed white and yellow spots. Discoloration of teeth and turning into brown and black streaks or spots on the enamel surface.

Loss of teeth at early age:

The teeth, once affected by dental fluorosis, cannot be reversed to normal. Only discolored teeth can be masked by the methods as prescribed below: Bleaching of teeth, Filling with high cure material and laminated veneering. Capping or crowning of teeth with metals like chrome, cobalt, gold, porcelain and acrylic.

10.Skeletal Fluorosis

Excessive quantity of fluoride deposited in the skeleton , which is more in cancellous bone than cortical bone .Fluoride poisoning leads to severe pain associated with rigidity and restricted movements of cervical and lumber spine , knee and pelvic joints as well as shoulder joints . In severe cases of fluorosis, there is complete rigidity of the joints resulting in stiff spine described as “bamboo spine”, and immobile knee, pelvic and shoulder joints. Crippling deformity is associated with rigidity of joints and includes kyphosis, scoliosis, and flexion deformity of knee joints, paraplegia and quadriplegia.

11.The Symptoms Of Skeletal Fluorosis Are As Given Below

Pain in neck, back bone or joints, Stiffness in the neck, backbone or joints severe pain and rigidity in the hip region (pelvic girdle) Construction of vertebral canal and inter vertebral forearm exerts pressure on nerves and blood vessels leading to paralysis and pain. Skeletal fluorosis is an irreversible process as the dental fluorosis.

12.Non – Skeletal Fluorosis

This kind of fluorosis is often overlooked due to misconception that fluoride affects only bone and teeth. Fluoride when consumed in excess can cause several other kinds of manifestations;

12.1.Neurological

Nervousness, depression, tingling sensation of fingers and toes, excessive thirst and tendency to urinate more frequently.

12.2.Muscular

Muscle weakness, stiffness, pain in muscles and loss of muscle power.

12.3.Allergic

Very painful skin rashes, which are perivascular inflammation prevalent in women and children, pinkish red or non- persistent oval shaped bluish - red spots on the skin.

12.4.Gastro-Intestinal

Acute abdominal pain, diarrhea, constipation, blood in stool tenderness in stomach.

Urinary tract: Urine may be less in volume, red in colour and passed with itching and sensation.

13. Drug Induced Fluorosis

The prolonged use of drugs containing sodium fluoride is known to cause skeletal fluorosis. During 1982, two cases of drug induced skeletal fluorosis were reported from Switzerland. Patients of rheumatoid arthritis received uninterrupted and prolonged treatment with niflumic acid. The daily dose of drug administered was 3 capsules of 250 mg niflumic acid (Nifluril, UPSA Laboratories, France).

Fluoridated toothpastes and mouth rinses recommended for mouth hygiene may cause drug induced fluorosis, particularly if the user is exposed to high fluoride water consumption. The blood vessels in the oral mucosa and the sublingual blood vessel absorb fluoride from these preparations. The commercial mouth rinses are generally fluoridated preparations with very high fluoride content.

14. Industrial Fluorosis

A number of industries use hydrofluoric acid and fluoride containing salts, in the different sections of an industry for one reason or other. The industries that use fluoride are;

- 1) Aluminum
 - 2) Steel
 - 3) Enamel
 - 4) Pottery
 - 5) Glass
 - 6) Bricks
 - 7) Phosphate Fertilizer
 - 8) Welding
 - 9) Refrigeration
 - 10) Rust Removal
 - 11) Oil Refinery
 - 12) Plastic
 - 13) Pharmaceutical
 - 14) Tooth paste
 - 15) Chemical Industries
 - 16) Automobile Industry etc.
- Fluoride dust and fumes pollute the environment; inhaling the dust and fumes is as dangerous as consuming fluoride containing food, water or drugs.

Some effects of fluoride on the basis of their concentration are given in the below table:

Concentration of fluoride	Medium	Effects
1 ppm	Water	Dental caries reduction
2ppm or <2ppm	Water	Mottled enamel(dental fluorosis)
8ppm	Water	10% osteosclerosis
20-80mg/day	Water or food	Crippling skeletal fluorosis
50ppm	Water or food	Thyroid changes
100ppm	Water or food	Growth retardation
125ppm	Water or food	Kidney changes
2.5-5.0ppm	Acute dose	Death

Table 1

Industrial fluorosis is a serious problem in the developed western and other industrialized countries. However, due to rapid industrialization in India, the problem of industrial fluorosis is reaching an alarming state and is compounding the problem of endemic, water and food borne fluorosis.

15. Conclusion

It has been observe that many diseases and health problems have been generated due to the excess intake of fluoride in the drinking water. Fluoride poisoning can be prevented or minimized by using alternative water sources, by removing excessive fluoride from drinking water, and by improving the nutritional status of populations at risk. Some governments are not yet fully aware of the fluoride problem or convinced of its adverse impact on their populations. Efforts are therefore needed to support more research on the subject and promote systematic policy responses by governments.

16.Reference

1. Agarwal V, Vaish A K and Vaish P 1997. Ground water quality: Focus on fluoride and fluorosis in Rajasthan. Current Science, Vol.73, no.99. pp 743-746.
2. SARITA 1995. Severity of Fluoride pollution in drinking water of the rural sector of Dungarpur district of Rajasthan, Final Project Report, 104 pp.
3. Susheela, A. K; Fluorosis management programme in India Current Science, 77, 1250. (1990).
4. Rani, Bina, Fluoride and fluorosis in Rajasthan: An Overview, A project Report [IGNOU], 2006
5. Prevention and control of fluorosis in India, Rajiv Gandhi National Drinking Water, Mission 1993
6. Choubisa, S, L; Fluoride distribution and fluorosis in some villages of Banswara district of Rajasthan, Ind. J. Environ. Health 39 (4) (1997) 281–288.
7. RGNDWM, Prevention and control of fluorosis in India. Health aspects, Ministry of rural Development, CGO complex, 1993.
8. Defluoridation of Drinking Water: Efficacy and Need Anurag Tewari*, Ashutosh Dubey A.Tewari et al Journal of Chemical and Pharmaceutical Research 2009, 1 (1):31-37
9. UNICEF's Position on Water Fluoridation 2001.