

## Fluoride Contamination of Water in India and its Impact on Public Health

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**Abstract:** Water contamination is one of the major effect on public health in India. Fluoride pollution in water is a main difficult across the world, with health dangers such as dental and skeletal fluorosis. Drinking water sources found in nature as both surface and groundwater are polluted with abundant polluting elements Fluoride. This review paper mainly focused on the effect of polluting elements on resources of water in India considering nearly a century on fluoride contamination in water. It is recommended for purpose of drinking water having lesser concentration then 1.5 mg/L fluoride to avoid additional fluorosis risks. Concerning the various reports that stated increased fluoride level in water resources, it is vital that further studies to be conducted to inspect whether there is a link of humans between fluoride and its effect on central nervous system. The overdose of sodium fluoride is death. There is an urgent need to make people aware about the methods of rainwater harvesting and to get fluoride-free water.

**Keywords:** Water, Fluoride, Pollutions, Drinking, Forensic, Human Health, Effect, etc.

### 1. INTRODUCTION

Water is essential for all physiological activities associated with humans, animals, and the plant kingdom. However, the nature and the quality of surface and ground water are widely variable and are determined by the local geological history, including the rocks and hidden ore deposits nearby the sites for the assembly of the water, and other issues, such as the effort of fundamental elements and contaminants by lentic and lotic waters and alternative aquifers [1].

The quality of water is poorly understood due to the variety in the interactions between water and soluble minerals, sparingly soluble minerals, and salts, both natural and anthropogenic [2]. Fluoride (F) come to be toxic once it happens in drinking water away from the extreme permissible limit of 1.5 ppm Chronic exposure to fluoridated ground or drinking water creates a health problem not only in human beings [3,4] but also in diverse species of domestic animals [5,6] in the form of osteo-dental fluorosis. In recent times, bio-indicators of common fluorotoxicosis due to fluoridated water [7, 8].

In India, several states are endemic for hydrofluorosis due to the high F content in drinking water [9, 10]. Various reports present conflicting data about the availability and quality of drinking water to the public in the country [11]. Weathering of these fluorine rich minerals is the most important geogenic source of fluoride enrichment in water. Anthropogenic sources also contribute fluoride in the water.

This includes activities such as mining, usage of pesticides and brick kilns [12]. Excess fluoride intake leads to dental fluorosis and at even higher intake could cause skeletal fluorosis. Hence, various national and international agencies have set standard permissible limits for fluoride in drinking water. The permissible limit set by WHO as well as Bureau of Indian Standards (BIS) for fluoride in drinking water is 1.5 mg/L [13, 14].

### 2. WATER CONTAMINATION MAJOR SOURCES OF FLUORIDE

The sources could be both geogenic such as the presence of fluorine-bearing minerals in rocks and sediments as well as anthropogenic such as use of

pesticides and industrial waste. The details of both of the sources are discussed below [15].

### 2.1. Anthropogenic

The major anthropogenic sources of fluoride pollution in water are instinctive use of phosphate fertilizers [16]. This is very common in developing countries such as India. Aluminum melting, glass, phosphate fertilizer, brick manufacturing and coal-based thermal also give fluoride into the environment [17]. Irrigation by fluoride-enriched water also contributes fluoride into groundwater [18]. It is estimated that up to 0.34 mg/L of fluoride can be contributed by the use of superphosphate fertilizers in agricultural land [19]. Areas nearby brick oven productions also show a higher concentration of fluoride in groundwater [20]. Clay used in the manufacture of bricks contains several hundred ppm of fluoride [21]. A research in the Republic of South Africa has shown that underground mine waters may contain high fluoride concentration of levels beyond 3 mg/L [22].

### 2.2. Mineral Extraction

Mineral process actions can also products significant fluoride pollution, both from direct extraction processes (which typically entail size reduction - greatly increasing the surface area for mass transfer - and generate effluents) as well as through leaching from ore and tailings stockpiles [23].

### 2.3. Mobilization of Fluoride

The concentration of fluoride in natural water depends on many factors. This includes temperature, pH [24], solubility of fluorine-bearing minerals, anion exchange between hydroxyl and fluoride ions, water residence time and the geological formations [25]. The process of mobilization is still unclear, but the most common mechanism for fluoride mobilization is displacement of fluoride ions (F-) by hydroxyl ions (OH-) [26, 27]. Temperature and residence time speed up the dissolution of fluorine bearing minerals present in the rocks [28].

**Table 1.** Range of fluoride in groundwater in different parts of the India

State/Locality/Area/Country	Fluoride range (mg/L)	References
Chandrapur, Maharashtra	0.27–5.3	[29]
Yavatmal, Maharashtra	0.30–13.41	[30]
Karbi Anglong district, Assam	20.6	[31]
Guwahati, Assam	0.18–6.88	[32]
Rohtas district, Bihar	0.1–2.5	[33]
Gaya district, Bihar	0.19–14.4	[34]
Raigarh district, Chhattisgarh	8.8	[35]
Durg, Chhattisgarh	13.2	[36]
Delhi	0.10–16.5	[12]
Delhi	0.02–4.13	[37]
Roopnagar, Delhi	7.14	[38]
Delhi	1–5.12	[39]
Ahmadabad, Gujarat	0.56–0.72	[40]
Mehsana and Banaskantha, Gujarat	1–6.53	[40]
Sirsa city, Haryana	0.1–1.9	[41]
Hisar, Haryana	0.03–16.6	[42]
Damodar River basin, Jharkhand	0.1–6	[43]
Gulbarga, Karnataka	2.60–7.40	[44]
Palghat, Kerala	5.75	[45]
Chandidongri, MP	1.5–4	[46]
Chhindwara, MP	0.06–4.74	[47]
Ranga Reddy district, AP	0.5–4.5	[48]
Anantapur district, AP	5.80	[49]
Imphal, Manipur	0.21–1.78	[50]
Puri, Orissa	16.4	[51]
Pushkar valley, Rajasthan	0.19–13.49	[52]
Nagaur, Rajasthan	0.4–6.6	[53]
Bhilwara district, Rajasthan	0.2–13	[54]
Jaisalmer, Rajasthan	0.08–6.6	[55]
Ajmer, Rajasthan	0.12–16.9	[56]
Agra, UP	0.2–3.2	[57]
Saidabad Tehsil, Mathura, UP	0.1–2.5	[58]
Bundelkhand, UP	0.01–4.10	[59]
Kancheepuram, TN	1.21–3.24	[60]

### 3. FLUORIDE IN WATER & EFFECT ON HUMAN HEALTH

Fluoride are highly electronegative element has extraordinary propensity to get concerned by +Ve charged ions like calcium. Later the effect of fluoride on mineralized muscles like over sweat, urine and stool. The strength of fluorosis is not only depends on the fluoride contaminated in water, but also on the fluoride from other sources, physical activity and dietary habits [61, 62].

#### 3.1. Dental Fluorosis

Due to excessive fluoride intake, enamel loses its luster. In its mild form, dental fluorosis is characterized by white, opaque areas on the tooth surface and in severe form, it is manifested as yellowish brown to black stains and severe pitting of the teeth. This discoloration may be in the form of spots or horizontal streaks [63]. Generally dental fluorosis depends on the quantity of fluoride exposure teen age, as fluoride marks only the emerging teeth while they are being shaped in the jawbones and are still below the gums. The major effects of dental fluorosis may not be specious if the teeth are previously fully grown prior to the fluoride over exposure. The fact that an adult displays no marks of dental fluorosis does not essentially mean that his or her fluoride taken is below permissible limit [64].

#### 3.2. Skeletal Fluorosis

Skeletal fluorosis affects children as well as adults. It does not easily manifest until the disease attains an advanced stage. Fluoride mainly gets deposited in the joints of neck, knee, pelvic and shoulder bones and makes it difficult to move or walk. The symptoms of skeletal fluorosis are similar to spondylitis or arthritis. Early symptoms include sporadic pain, back stiffness, burning like sensation, pricking and tingling in the limbs, muscle weakness, chronic fatigue, abnormal calcium deposits in bones and ligaments. The advanced stage is osteoporosis in long bones and bony outgrowths may occur. Vertebrae may fuse together and eventually the victim may be crippled. It may even lead to a rare bone cancer, osteosarcoma and finally spine, major joints, muscles and nervous system get damaged [64].

#### 3.3. Other Problems

This characteristic of fluorosis is frequently overlooked because of the concept prevailing that fluoride only effects on the bones and teeth

[65]. Further dental fluorosis and skeletal extreme consumption of fluoride may lead to muscle fiber collapse, low levels of hemoglobin and abnormalities in RBCs, extreme thirst, headache, skin rashes, nervousness, neurological manifestations, depression, gastrointestinal problems, urinary tract malfunctioning, nausea, abdominal pain, tingling in the all body parts and mainly affected area fingers & toes, reduced immunity, repeated abortions or still births, male sterility, etc. It is also responsible for alterations in the functional mechanisms of liver, kidney, digestive system, respiratory system, excretory system, central nervous system and reproductive system, destruction of about 60 enzymes. The effects of fluoride in drinking water on animals are analogous to those on human beings. The continuous use of water having high fluoride concentration also adversely affects the crop growth [64].

### 4. DISCUSSION

These Review paper studies show that in India many regions ground water and river water are contaminated with the high amount of fluoride pollutants. Their quantities are far above the permissible levels according to national guidelines of drinking water and WHO, USEPA standards. The contamination of water with fluoride is going to develop a serious health problem in coming years. In Indian perspective, highly contamination fluoride in water is commonly observed in areas with high water salinity and observed that this highly concentration fluoride in water is commonly restricted to rainfall deficient areas. Possibly in such ranges, low groundwater drain facilitates discharge of fluoride in groundwater system. The toxicologist has frequently detected the fluoride concentration in many water bodies. Human health is directly affected by the intake of polluted fluoride water, fish, etc. High amount fluoride concentration is effect on produced etrimental chemical & Biological functional modifications in the development of human brain. Exposure may originate with fluoride in the maternal blood transfer from the placenta to the fetus and continues throughout childhood from fluoride contaminated drinking water.

### 5. CONCLUSION

Several deaths due to high concentration of fluoride poisoning on human. The cause of death in the acute & chronic fluoride was taken in high concentration by water or food and found poisoning with the fluoride levels in the

gastric contents and blood being High permissible limit by WHO, USEPA respectively. These fluoride concentrations were very high and sufficient to cause death in agreement with the report of the post mortem examination. The practice of fluoride detection should be continued to avoid possible consumption of contaminated eatables. It is recommended that awareness should be spread among the people regarding the hazards on consumption of polluted water and related eatables.

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**Citation:** Mahipal Singh Sankhla, Rajeev Kumar. *Fluoride Contamination of Water in India and its Impact on Public Health*. *ARC Journal of Forensic Science*. 2018 3(2):10-15. <http://dx.doi.org/10.20431/2456-0049.0302002>

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