

Can People Get Fluorosis from Drinking Water from Surface Water Sources? Fluoride Test of Water Mandatory Before its Supply

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Article information

Received: Oct 13, 2023

Accepted: Dec 04, 2023

Published: Dec 11, 2023

SciBase Epidemiology and Public Health - scibasejournals.org

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Citation: Choubisa SL, Choubisa D, Choubisa A. Can People Get Fluorosis from Drinking Water from Surface Water Sources? Fluoride Test of Water Mandatory Before its Supply. SciBase Epidemiol Public Health. 2023; 1(2): 1006.

Abstract

It is true that the groundwater of most areas of the world is almost fluoridated with varying concentrations. There are many countries, including India, whose drinking groundwater contains fluoride more than the parameters set by World Health Organization (WHO) that is 1.5 ppm. Drinking such fluoridated water repeatedly and for a long time causes dangerous fluorosis disease in people. This disease remains life-long in people and there is no permanent cure till now. Thousands of people around the world are suffering from this disease. Generally, the water of surface water sources (puddles, rivers, canals, streams, lakes, ponds, dams, reservoirs, etc.) is considered to be free of fluoride. However, according to WHO, its quantity in the water of different surface water sources has been estimated from 0.01 to 0.3 ppm. But recent studies revealed that in many of these freshwater sources, the amount of fluoride was found to be more than 1.0 ppm or 1.5 ppm. If such water is used for drinking for long time, then the health of the people gets affected and there is a possibility of getting dreaded fluorosis disease. Due to fluorosis, people's teeth become weak and discoloured (dental fluorosis) and their diverse skeletal bones become porous, weak, and deformed (skeletal fluorosis). People also become hunchbacked (kyphosis) and lame (crippling) for life due to this disease. Many health complaints such as gastrointestinal discomforts, polydipsia, polyuria, repeated abortion, impaired reproduction and endocrines, neurological disorders, etc. are also found in people afflicted with chronic fluoride intoxication. If animals also start drinking this water for a long time, then they also get this dangerous disease. In rural areas, this water is also used for agricultural irrigation which also causes serious anomalies in diverse species of agriculture crop plants and ultimately reduces annual agricultural yield. However, before supplying drinking water to the human population from any of surface water sources, the water of these sources must be tested for evidence of fluoride. From the point of view of health, if the amount of fluoride is found to be more than the prescribed parameters, the water supply of such water sources should not be done as far as possible. The present communication highlights various potential adverse consequences in humans from drinking water from surface water sources containing fluoride above the permissible or acceptable limit or level.

Keywords: Chronic fluoride intoxication; Dental fluorosis; Fluoride; Fluorosis; Surface water sources; Non-skeletal fluorosis; Skeletal fluorosis.

Introduction

It is well known that the groundwater of many countries of the world has been found to be contaminated with fluoride and most of the groundwater sources (hand-pumps, bore-wells, deep dug-wells, etc.) contain fluoride above the permissible value of 1.0 or even 1.5 ppm [1-3]. Drinking such fluoridated groundwater having different fluoride concentrations is not safe for health and causes a serious disease called fluorosis not only in humans [4-23] but also in various species of domestic [24-49] and wild animals [50-52]. Due to the toxic effects of fluoride, people's teeth become discolored, weak, and fall out soon (dental fluorosis), while their skeletal bones become hollow/porous, crooked, and deformed (skeletal fluorosis). The victims of this disease bend their back (kyphosis deformity) and walk with a limp (crippling deformity) [15,16]. Generally, these deformities in teeth and bones are irreversible and remain for life.

In various rural and remote areas of the world, where there is no arrangement for the supply of drinking water or there is a crisis of drinking water, then the people living there usually use water from surface water sources like puddles, ponds, lakes, springs, ponds, reservoirs, dams, etc. (Figure 1) not only for drinking but also for cooking and other domestic purposes. But due to lack of information especially among the rural people, there is a belief that the water of these freshwater sources is free from contamination with fluoride. However, according to World Health Organization, the amount of fluoride in these water sources is found in the range of 0.01-0.3 ppm [1]. But, according to the recent several research survey studies, the amount of fluoride in several surface water sources has been found to be more than the prescribed parameters or even more than 5.0 ppm [53-59]. Therefore, drinking of such water is not safe for human health and causes a serious fluorosis disease in them [1,15,16]. In present communication or review, the possible diverse adverse toxic effects caused by drinking of fluoridated water from surface water sources are highlighted and also focused on how to prevent and control chronic fluoride intoxication in human population.



Figure 1: The villagers fetch water for drinking and cooking from various common surface water sources such as river (Figure a), pond (Figures b and e), canal (Figure c), and small reservoir (Figure d) located near their villages.



Figure 2: Dental fluorosis (brownish staining on enamel) in child due to drinking of fluoridated water.



Figure 3: Villagers are suffering with mild to severe skeletal fluorosis (genu-varum deformity in legs) due to drinking of fluoridated water.

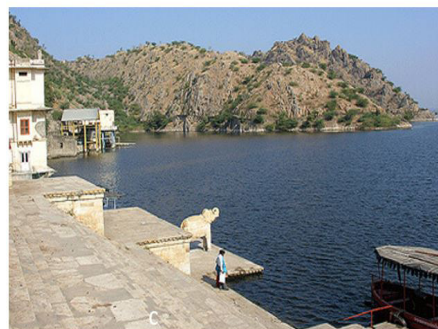
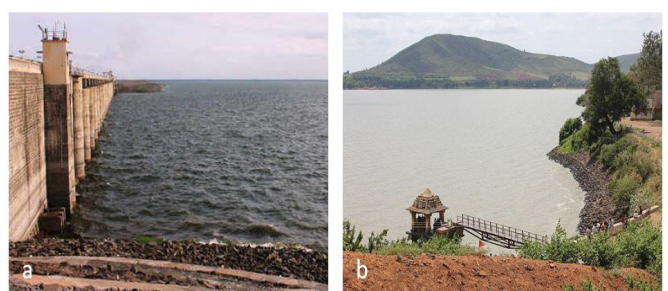


Figure 4: Various surface water sources, dam (Figure a), large pond (Figure b), and lake (Figure c) used for both community water supply and irrigation for agriculture.

Fluoridated surface water and its intoxication (fluorosis)

Generally, the people of the villages use the water of various freshwater sources located nearby for drinking water. But they do not know whether there is fluoride in the water of these sources or not. Still, the villagers use the water of these sources not only for drinking, but also use it for cooking. On using fluoride, it enters the human body not only through drinking but also through food. In fact, fluoride is not an essential element for human growth and development and for most organisms in the environment [60] and is also an undesirable substance in animal feed [61]. However, it has vital role or contribution in strengthening and mineralization of teeth and dental enamel in both humans and animals.

Once fluoride enters the body through drinking and/or eating, it is absorbed by the digestive system. From this system it reaches to various organs or soft tissues of the body through blood circulatory system. More than 50% absorbed fluoride is excreted from the body through excretory products, faeces and urine, and perspiration as well, while rest is retained in the body where it accumulates gradually in various organs. But due to it has greater affinity with calcium, its maximum bio-accumulation is occur in the calcified tissues, bones, and teeth compared to non-calcified tissues or soft organs. This bio-accumulation of fluoride causes toxic effects or adverse changes and interference in physiological and biochemical or metabolic processes which ultimately trigger the genesis of adverse reversible and non-reversible toxic health effects. These fluoride-induced toxic or health changes are collectively known as fluorosis [1,15]. Various fluoride induced anomalies or deformities in teeth and bones are permanent, irreversible, and untreatable and can also be identified visually. But the fluoride induced changes in soft tissues or organs are reversible and disappeared when check or remove the fluoride exposure.

If people regularly consume freshwater containing fluoride above 1.0 ppm or 1.5 ppm for drinking and cooking for a long time, it becomes toxic to health and develops a serious fluorosis disease. This disease can appear in all age groups and in both genders [62,63]. Due to this disease, people's teeth become discolored or horizontal stratified blackish or brownish staining (Figure 2), which gradually become weak and start breaking and falling. The various fluoride-induced changes in teeth are collectively known as dental fluorosis. On the other hand, due to chronic fluoride intoxication, people's bones become porous and deformed with varying grades [8,64,65]. Because of this many people become hunchbacked and walk with a limp (Figure 3). When its toxicity increases, a variety of physical deformities develop, such as kyphosis, genu- verum or valgum syndrome, paraplegia, quadriplegia, and even disability. These deformities remain for life, for which there is no cure? skeletal fluorosis is a common term for multiple skeletal bone changes or deformities caused by chronic fluoride poisoning, which are extremely painful [1,15,16]. However, the severity of these fluoride-induced changes or osteo-dental fluorosis depends on the level of fluoride in drinking water and the frequency of its exposure and many other factors like chemical constituents in drinking water, age, gender, habits, food nutrients, environmental factors, individual susceptibility, and biological tolerance, health and genetics of an individual [66-73]. Apart from these, many types of health problems (non-skeletal fluorosis) such as gastrointestinal discomforts, anaemia, body weakness, polydipsia, polyuria, repeated abortion, impaired reproduction and endo-

crines, neurological disorders, etc. also can also be develop in people of all age groups due to drinking of fluoridated water. However, studies on chronic fluoride toxicity in human population due to drinking of fluoridated freshwater are still limited in fluoride endemic countries [74]. Therefore, more surveys on water fluoride assessment of diverse lentic (stagnant) and lotic (running) surface water bodies located close to the locality of human population in different geographic provinces are highly suggestive. For the prevention and control of fluorosis disease in human population it is an important and necessary to provide or supply fluoride free water. This can also be done by adopting Nalgonda defluoridation technique which is an ideal technique can be used both at household and community level [75]. To ensure that people do not suffer from fluorosis, it is mandatory or necessary to test the water of different surface water sources for fluoride before supplying it. If the amount of fluoride in water exceeds the prescribed standards, then water supply should not be supplied to the population as far as possible.

In addition to humans and animals, regular fluoride exposure through irrigation (Figure 4) of fluoridated water, and/or industrial fluoride pollution also causes diverse adverse health effects in various species of agricultural crops [76-79]. In fact, the bio-accumulation of fluoride in different parts of plants triggers the generation of diverse toxic effects. The most common visible morphological changes induced by fluoride in crop plants are dwarfism syndrome (stunted growth), necrosis, chlorosis, leaf damage, tip burn, and inward rolling of leaves[76,79,80,81]. In fact, fluoride has the potential to adversely alter many physiological processes including photosynthesis, seed germination, CO₂ assimilation, respiration, protein and nucleotide synthesis, carbohydrate metabolism, hormonal imbalance, inhibition of various enzyme activities, gene expression patterns, and inhibition in the developmental and reproductive capabilities, etc. Ultimately, these fluoride-induced changes affect the annual agricultural productivity, causing huge economic losses to farmers.

Conclusion

Fluoride is not only found in groundwater naturally but it is also found in diverse lentic and lotic surface water bodies. Several studies revealed that in many of these surface water sources contain fluoride more than the permissible value 1.0 ppm or 1.5 ppm. If regular drinking of such water for prolonged period than it is not safe for the human health and causes a serious disease called fluorosis. In fact, fluoride damage not only teeth and bones but also affects diverse organ systems of the human and animals. The adverse changes in teeth and bones are, generally, irreversible and untreatable. To avoid this disease in human population, it is necessary to provide fluoride free water. This can also be possible by adopting Nalgonda defluoridation technique which is an ideal technique and can be used both at domestic and community level. Before the supply of fresh water in community fluoride estimation of water is mandatory. If its level is found beyond the permissible level then supply of such water should checked. However, studies on consumption fluoridated surface water and its chronic toxicosis in human are still limited. Therefore, more surveys on water fluoride assessment of diverse fresh water bodies located close to the locality of human population in different geographic provinces are highly suggestive.

Declarations

Competing interest: Authors declare no conflict of interest re-

garding this work.

Funding source: There is no any funding source for this work.

Acknowledgements: The author thanks to Dr. Pallavi Choubisa, Department of Gynaecology and Obstetrics, District Hospital, Salumber, Rajasthan 313002, India for cooperation.

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