REVIEW ARTICLE

Keep Away from Fluoride: A Toxin for Human Health

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ABSTRACT:
Fluoride is considered as safe when taken in permissible amount; in case of excessive consumption, it causes multiple ill effects on human body such as elevation of thyroid hormone. This literature review was carried out to evaluate the impact of fluoride on human health and then enlighten healthcare personnel including dentists and physicians whether consumption of fluoride is beneficial or harmful. Ample literature is available which revealed that there is only one advantage; to prevent tooth carries when fluoride is topically applied in permissible value, and there are more harmful effects of excessive fluoride ingestion on human health. An individual can have 1.5mg/L of fluoride by inhalation or ingestion from all resources, namely food, air, and environment to prevent dental decay. One can additionally use topical fluoride over the teeth so that there would not be the need of community water fluoridation which can lead to lethal health outcomes.
Keywords: Fluorine, , Flourosis, Hypothyroidism, Impact

INTRODUCTION:

Fluorine (F-) is highly reactive electronegative element, green to pale yellow in color and univalent gaseous halogen, present in a very less quantity in plants, air, water, salt, beverages and animals and it is the 13th most abundant element on earth. It comprises of 0.08% of earth crust[1]. In water medium fluorine is present in the form of fluoride; and is vital for the prevention of tooth decay and provides density to human bone[2, 3]. Fluorine is found in environment in the form of fluoride minerals composed of carbonate, calcium, sulphates[4], mainly found on volcanic belt from Turkey to China, including infertile region of Mexican border and USA, and another volcanic belt of Pacific region[5]. According to WHO, permissible amount of fluoride in human being is 1.5 mg/L to prevent tooth decay[1, 3].

Fluoride had been added in water from 1940s with the credence that ingested fluoride provides benefit for caries protection and prevents dental decay during tooth forming years. Recently dental community has recognized the fact that topical application of fluoride provides primary benefit as compared to ingestion of fluoride[6]. In water fluoridated areas, the estimated adult fluoride intake by food and water is between 1.2 and 2.2 mg/day (0.02-0.03 mg/kg) and food for young children is 0.04-0.07 mg/kg of body weight according to National Research Council 1993[7].When fluoride exceeds from permissible amount via diet; for example tea, meat, water, salt, tooth paste, dental products, cereals, fish, air, beverages, vegetables and fruits, canned food, chocolates, fluoride supplements and environment, then it has adverse effects on human body which include first and very important dental flourosis[3], osteoporosis, hypothyroidism[3,7]; and impairs normal functioning of bones, kidney, muscle, nerves and reproductive organs[3]. Multiple researches have revealed that excessive exposure of fluoride has a relationship with decreased mental ability and IQ level of children[3, 8].

Fluoride is present in all sources of water, in fresh water 0.01 to 0.3 ppm, in sea water 1.2-1.5 ppm[9]. Fluoride is extracted from soil in a very low quantity but plants which grow in acidic soil have exuberant fluoride levels, up to 100 ppm as in some of the tea plants[9,10]. According to WHO permissible limit of fluoride in Pakistan is 1.5ppm in drinking water and one of the studies conducted in 23 big cities of Pakistan supervised by National water quality Monitoring Program revealed that due to the effluents and industrial disposal, fluoride level reached to the toxic levels[11]. Another study revealed that in Lahore city, the content of fluoride in drinking water was within the safe limit as compared to adjacent areas like Mangamandi which had higher fluoride content and the number of reported cases of dental and skeletal flourosis among the natives were also high[12]. According to the Centre of disease Control (CDC), dental decay is related to the low level of fluoride in drinking water and to overcome this tooth decay water fluoridation is one of the developments on public health aspect[13, 14].

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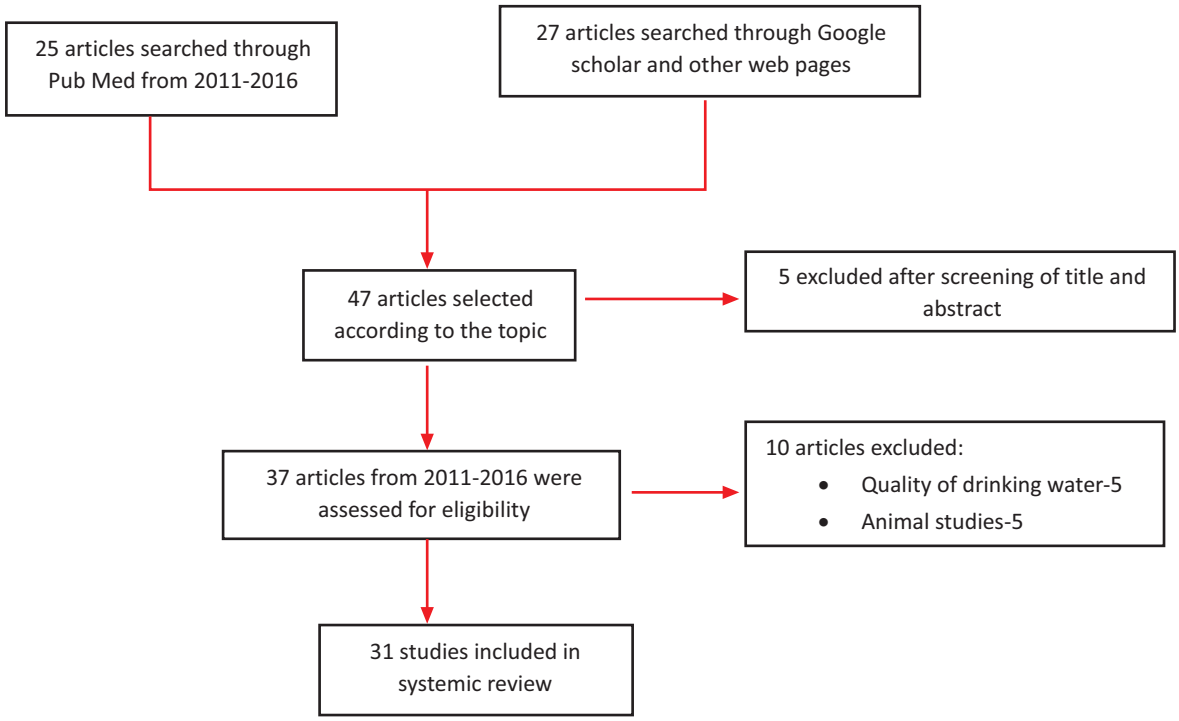
It is evident from literature that water fluoridation may induce high levels of fluoride in body along with different potential sources of fluoride from food and environment. It is imperative to review literature and gather authentic data from different researches conducted worldwide to help the physicians, dentists and health care personnel by providing them evidence based outcome when prescribing fluoride supplement to their patient and evaluate fluoride as a toxin instead of benefit for the human body. This was indeed the aim of this study.

METHODOLOGY:

The literature was reviewed and systemically searched from international search engines for example Medline and Google scholar. This literature search was carried out from 1st July 2016 till 30thSeptember 2016, and was limited from 2011 till 2016. The used key words were impact of fluoride on human health, effects of water fluoridation, impact of water fluoridation in Pakistan and causes of dental and skeletal flourosis. By exploring with these key words total 52 articles were retrieved and 31 articles were filtered by focusing on the topic (Table-1.) In additions to the mentioned topics, more articles were further explored from the references of the filtered articles to get more literature.

Table-1: Inclusion and exclusion flow chart of retrieved literature



LITERATURE REVIEW

Effect of Fluoride on Dental and Human skeleton:

Consumption of fluoride for the protection of dental decay is a very old practice. Water quantity of 1 ppm of fluoride can prevent the tooth decay and does not have negative impact on enamel strength[3,15]. Excessive consumption of fluoride in human body can cause flourosis. It is of two types; dental or skeletal. Dental flourosis also known as "mottled enamel", is hypo mineralization of enamel during the period of enamel development till the eruption of permanent dentition (1-6 years). If fluoride level reaches up to toxic level (1-4 ppm), it may cause brittleness and weakness in joints and can lead to fractures of hip and wrist joints due to the chronic exposure to excessive fluoride for long duration and less consumption of calcium[16]. According to National Research Council U.S; skeletal flourosis is prevalent in Asian subcontinent. The severe presentation is "crippling skeletal flourosis", which causes severe pain in joints, bone deformation, calcified ligaments and immobility. Major reason of dental flourosis is badly chosen dental products[17]. 70% of the searched articles revealed harmful effects of dental and skeletal flourosis in their study[3,6,18-23]. Skeletal flourosis leads to osteoarthritis, followed by stiffness of joints, sporadic pain, joint stiffness, osteosclerosis of vertebral column and pelvic girdle, restricted chest wall expansion and

slight calcification of ligaments[6,24-26].

Effect of Fluoride on Cognitive Impairment and IQ level of Children:

Multiple studies were carried out to examine association between excessive fluoride and IQ. Community water fluoridated areas showed no association between fluoride and IQ. In fluoride belt countries, association was found between IQ and neurological effects with excessive fluoride from 1.5 ppm to as high as 10.3 ppm. Human studies conducted in Mexico, Iran, India, and China revealed causal association between excessive fluoride ingestion and IQ level of children and developmental neurotoxicity even after controlling different elements like lead and arsenic; iron and iodine were also present in water[6,18,19, 26-29]. Lower socio-economic status and malnutrition also lead to lower IQ and neurological problems in children[3,28].

Effect of Fluoride on neurological system:

According to a study in 2011; toxic level of fluoride in human body can affect the central nervous system and interfere with the normal functioning of neurons, this is mostly reported near the areas of fluoride belt and the population which are more exposed to industrial waste and chemicals depending upon the age, dose exposure and time[6,30]. Multiple studies conducted worldwide revealed that behavioural problems in neonates are also caused by accumulation of fluoride in fetal brain leading to its damage[6]. Another study conducted in China disclosed that augmented level of fluoride in drinking water is stumble upon neurotoxicity during development[31].

Effect of Fluoride on Endocrine System:

When the concentration of fluoride reaches from 100-200 ppm in human body; it increases the TSH level and ultimately diminishes the production of T3 & T4 and sensitizes thyroid gland as fluorine has the antagonist property towards iodine[3]. In early era of 20th century, administration of fluoride was an effective measure to suppress thyroid function and to treat hyperthyroidism[6].

Effect of Fluoride on Insulin:

In diabetic patients, increased level of fluoride from water and other sources can cause insulin resistance by increased hepatic glycogenolysis. Fluorides have an important role in stifling insulin secretion from islets of Langerhans and ultimately make obstruction in the process of glycolysis and raise blood glucose level[3].

Perinatal deaths and birth defects:

According to the study conducted in UK, 15% more perinatal deaths and 30% more cases of Down's syndrome were reported in fluoridated areas as compared to non-fluoridated areas. Water fluoridation was prohibited after this correlation was evidenced in Chile[6].

Oncological Effect of Fluoride:

Research in national Toxicology Program revealed that fluoride is a mutagen and causes genetic damage[6]. According to the study conducted in Japan, fluoride can not only cause genetic damage, but it has the ability to transform healthy cells into cancerous cells. Excessive fluoride deposits in bone changes the composition of bone mineralization, serum activity of alkaline phosphate increases, and increased osteoblastic proliferation can lead to osteosarcoma. A number of ecological studies were conducted to find association between osteosarcoma and excessive fluoride. An estimated 15 cases per year of osteosarcoma were diagnosed affecting all age groups in Ireland[3,6,32]. Another study confirmed the link between uterine cancer and excessive fluoride[6].

Effect of Fluoride on Gastrointestinal Tract:

Excessive fluoride ingestion within a short period of time can affect stomach by first damaging the mucosa of gastroduodenal junction, causing nausea, bloody diarrhoea and vomiting, and abdominal pain suggesting acute poisoning. These are early warning signs of flourosis[6]. Within two to four hours of excess fluoride ingestion, symptoms progress to shallow breathing, hypocalcaemia, hyperkalaemia, cyanosis and ultimately death[3,33]. From the reviewed articles 50% showed evidence of acute toxicity. Children under 4 years of age (1990-1994) experienced gastrointestinal distress due to the ingestion of fluoridated tooth paste and developed acute toxicity of fluoride[6,21,34].

Effect of Fluoride on Cardiovascular System:

Excessive fluoride, more than 2 ppm may cause decrease in aortic elasticity, oxidative stress, atherosclerosis, coronary cell damage, myocardial calcification and vascular stiffness causing high blood pressure and cardiac dysfunction. It is difficult to find association between excessive fluoride and cardiovascular disease, but a study conducted in China and two studies in Iran suggested more prevalence of high blood pressure in high fluoridated area[3,24].

Alzheimer's disease and Fluoride:

As stated by comparative epidemiological study that there is one-fifth prevalence of Alzheimer's disease in highly fluoridated areas as compared to low fluoridated areas[35]. A lot of more work needs to be done in this area to find out the causal relationship between Alzheimer's disease and excessive fluoride ingestion.

Effect of Fluoride on Iodine deficiency, hypothyroidism and depression:

Excessive amount of fluoride in the body leads to the decreased production of T3/T4 causing hypothyroidism. Iodine deficiency is the basic cause of hypothyroidism, which is one of the many predisposing factors of depression. It is most commonly found in Northern areas of Pakistan and other developing countries. Some researchers have declared that at specific level, fluoride can replace iodine as it is antagonist of iodine and leads to iodine deficiency in patients which in turn causes depression[3,7,8,12,36]. Worldwide, hypothyroidism made an alarming health situation mainly due to iodine deficiency and excessive fluoride[36,37].

By reviewing the literature, it can be stated that there is only one advantage of fluoride; which is prevention of tooth decay when consumed in permissible amount and applied topically, otherwise there is more negative impact of excessive fluoride in human body. Community water fluoridation had been carried out since 1940s as advancement in public health sector to provide fluoride in community water supply. According to the British government, water should be fluoridated at 1 ppm and along with other resources of fluorides; it exceeds permissible value when it reaches the human body leading to its negative impact[6, 38,39].

Public Health Services in US have revised the quantity of fluoride in community water supply, which was admissible since 1962, and recommended to add 0.7 ppm or milligrams/litre (mg/L) of fluoride in May 2015 in community water fluoridation, so it could balance the need of cavity protection and limit its harmful effects[40].

In Pakistan, the concentration of fluoride content is beyond the permissible limit, from 1.6-25mg/L according to the study conducted in 16 major cities of Pakistan over 747 surface water samples[37].

This is the point of rethinking, and appraising that is it necessary to fluoridate water for the prevention of dental caries as there are many other food and natural resources of fluoride intake. Accumulative ratio of fluoride has negative impact on human body. In Pakistan, more researches should be conducted to explore the excessive consumption of fluoride and its impact on human health and also review the content of fluoride in drinking water.

CONCLUSION:

Fluoride is present naturally in our environment. There is only one benefit and more risks to the general health. We should focus on benefit versus risk ratio while planning any public health approach. An individual can have 1-1.5 ppm of fluoride from all resources namely food, air, and environment and can prevent the dental decay. Additional fluoride should be used as topical application, so that there would not be the need of community water fluoridation which can lead to major lethal health outcomes.

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