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Chapter

Fluoride Content in Drinking Water and the Health Implications of Fluoride-Rich Water Consumption: An Overview of the Situation in Canada and Nigeria

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Abstract

Fluoride is an inorganic monatomic anion of fluorine and forms part of essential reagents used by the chemical industry. It occurs naturally in several minerals and in trace quantities in water. Fluoride has been used to prevent tooth decay and in the treatment of osteoporosis. Extensive research has consistently demonstrated the safety and effectiveness of fluorides in the prevention of dental caries following the practice of water fluoridation. Despite these benefits, fluorides pose danger as an endocrine disruptor thus, affecting bones, brain, thyroid gland, pineal gland and blood sugar levels. In Canada, water fluoridation remains a contentious issue although dental decay constitutes the most common chronic disease. However, several Canadians are receiving the benefits of water fluoridation and about 1% have access to naturally fluoridated water. In Nigeria, the prevalence of dental caries has been documented to be greatly reduced following fluoridation of public water supplies in areas where the condition was endemic. Fluoride is therefore the only medicine added to public water, and at the recommended level, fluoride is safe and effective in the reduction of dental decay and poses no risk for health problems. Hence, this article highlighted fluoride content in drinking water and the health implications of consuming fluoride-rich water with a focus on the situation in Canada and Nigeria.

Keywords: fluoride, water, dental decay, health

1. Introduction

Fluoride, an inorganic monatomic anion, is the simplest anion of fluorine and represented by the chemical formula F^- . Fluoride salts and minerals are essential chemical reagents and industrial chemicals used in the production of hydrogen fluoride for fluorocarbons. Fluoride ions occur on earth in several minerals,

particularly fluorite, but are only present in trace quantities in water and contribute a distinctive bitter taste [1, 2]. Fluoride is added to public drinking water, tooth-paste and mouthwashes to prevent tooth decay by protecting teeth from bacteria in plaque [3–5]. Also, fluoride is taken orally for the treatment of osteoporosis as well as for the prevention of bone loss in people with rheumatoid arthritis by promoting new bone formation [6]. Since the inception of water fluoridation, extensive research has consistently demonstrated the safety and effectiveness of fluorides in the prevention of dental caries [7–9]. Furthermore, there has been continual monitoring of this scientific literature by the world's major National and International Health Organizations, committees of experts and special councils of governments [8].

2. Effects of fluoride in the body (fluorosis)

Many assumption states that consuming fluoride only pose risk on dental health [10]. However, fluoride affects many tissues in the body besides the teeth [3]. Fluoride has been reported to be an endocrine disruptor that can affect the bones, brain, thyroid gland, pineal gland and blood sugar levels. The ability of fluoride to cause brain damage constitutes one of the most active areas of fluoride research and many studies have demonstrated that fluoride is a neurotoxin (a chemical that can damage the brain) [11]. Studies have demonstrated association of fluoride toxicity with varieties of health problems including increased lead absorption, disruption of collagen synthesis and muscle disorders, hyperactivity and/or lethargy, thyroid disease and lowered thyroid function, arthritis, bone fractures and bone cancer (osteosarcoma), dementia, genetic damage and cell death, increased cancer rate, disruption of the immune system and inhibition of antibodies formation and damage of sperms and increased infertility [3, 11–13].

Most developed countries do not fluoridate their water and countries that fluoridated their water do not have less tooth decay than countries that do not fluoridate their water [3]. Based on the few data available on fluoride in drinking water, there is an established relationship between dental caries and environmental fluoride in drinking water [14]. Although with decline in the water supply systems in most parts of Nigeria due to increasing human population demand, about 90% of people use groundwater (well and borehole) for drinking and other domestic purposes [15]. About 40% of American teenagers show visible signs of fluoride overexposure. In infants, fluoridated water provides no benefits but only risks. However, swallowing fluoride tablets provides little benefit to the teeth [14].

3. Water fluoridation in Canada

In North America, dental decay constitutes the most common chronic disease with over 96% of Canadians being affected [11]. The use of water fluoridation for the prevention of tooth decay has been used for over 60 years and is endorsed by various organizations, including Health Canada, the Canadian Public Health Association, the Canadian Dental Association, the Canadian Medical Association and the World Health Organization [3]. Approximately, 42.6% of public water supplies in Canada receive water fluoridation [16]. Over 13 million Canadian's are receiving the benefits of water fluoridation, while another 1% (270,000 people) has access to naturally fluoridated water [14]. As of 2011, the large Canadian cities without water fluoridation were Vancouver, Regina, Montreal and Calgary [4].

The recommended optimal level of fluoride (0.7 mg/L) [8] is set to promote public health benefits of fluoride for preventing tooth decay while minimizing the chance for dental fluorosis. The Guidelines for Canadian Drinking Water Quality states that the maximum acceptable concentration of fluoride in public water supplies is 1.5 mg/L to protect against health risks from exposure to too much fluoride [11]. However, with fluoride levels above 1.5 mg/L over a period of time, the effects of fluorosis are observed [8].

Water fluoridation remains a contentious issue in Canada and many communities chose to fluoridate their water supply [3]. As of 2007, 45.1% of the Canadian population had access to fluoridated water supplies [9, 11]. The main argument for and against fluoridation have changed very little over the years, with supporters (including the World Health Organization and Health Canada) citing evidence that shows fluoridation as a safe and effective method of caries prevention, while detractors cite high costs and potential health risks [17].

4. Water fluoridation in Nigeria

The mottling and staining of teeth (dental caries) previously believed to be an identity of certain ethnic groups or communities in Nigeria has been described to be associated with fluorosis [18]. Hence dental caries has extended beyond tribal or communal barriers as foreigners that came from far away Asia also showed evidence of this disease condition [15]. From records, the prevalence of dental caries was greatly reduced in areas where dental caries was endemic following fluoridation of public water supplies [3]. However in Nigeria, dental caries is endemic and epidemic mainly in the North Eastern half of Nigeria both in the crystalline basement and sedimentary areas. Also, fluoride values (0.2–8 mg/L) above the 1.5 mg/L WHO recommended level have been recorded in groundwater in Nigeria (Figure 1) [15, 20].

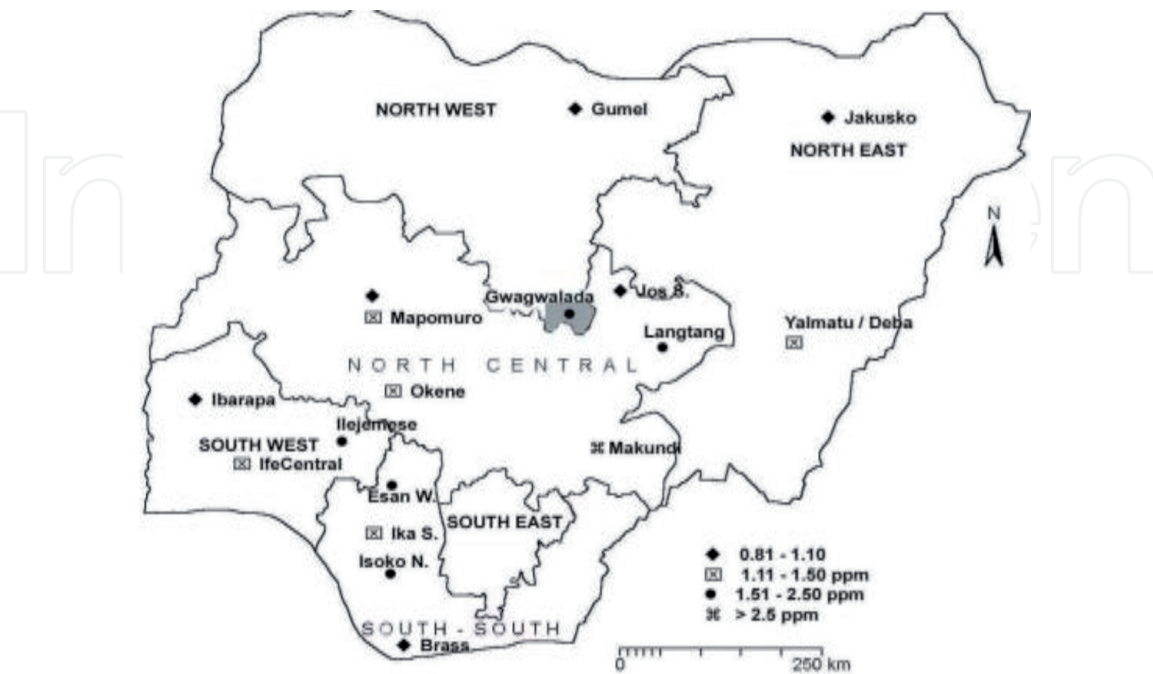


Figure 1.
Areas with drinking water containing fluoride levels higher than 0.8 ppm in the six geopolitical zones of Nigeria [19].

5. Conclusion

Fluoride is the only medicine added to public water, and water fluoridation at the recommended level is safe and effective in the reduction of dental decay and poses no risk for health problems. Hence, it will be of public health benefit to ascertain that the well-being of the populace is safe guarded by knowing the level of fluoride is within the acceptable limit. Also, there should be recommendation for compliance with the WHO guidelines to the permissible limit by the policy makers.

Conflict of interest

The authors declare no potential conflict of interest.

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