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Editorial

Protecting Children from Fluoride Contamination: A One Health Approach

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Punjab state is geographically divided into three major regions called Majha, Malwa and Doaba. This division of Punjab is basically due to the rivers Satluj, Beas and Ravi flowing through the land of Punjab.

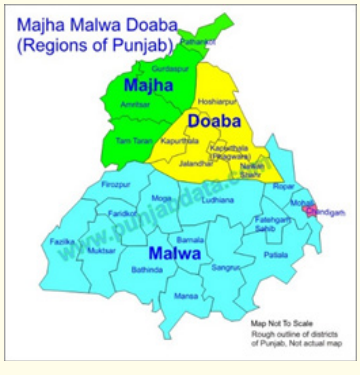

Figure 1: Malwa region of Punjab, India.

The region of Punjab towards the left bank of Sutlej river is called Malwa. Malwa extends upto Ambala district in Haryana, beyond the borders of Punjab state. Almost 60-70% area of Punjab state is part of this region [1]. Research indicates that several districts in the Malwa region, including Fazilka, Sri Muktsar Sahib, Bathinda, and Barnala, have groundwater with fluoride concentrations exceeding the World Health Organization's safe limit of 1.5 mg/L [2]. Elevated fluoride levels can lead to health issues such as dental and skeletal fluorosis. A study by the Central University of Punjab found that shallow wells (less than 60 meters deep) in these areas are particularly affected, making the water unfit for drinking and irrigation purposes [3]. a study focusing on the Muktsar district reported total hardness values ranging from 168 to 724 mg/L, with many samples exceeding the acceptable limit of 200 mg/L set by the World Health Organization [4].

Children in the Malwa region of Punjab are at risk of several health issues due to elevated fluoride levels and water hardness in groundwater. Fluoride levels in groundwater exhibited a significant correlation with total dissolved solids across all districts, except Moga. The findings indicated that the mean hazard quotients (HQs) exceeded 1 for all age groups in the districts of Bathinda, Mansa, Faridkot, and Muktsar. The assessment of non-carcinogenic risk among different age groups followed the order: children > teenagers > adults > senior citizens > infants. These results suggest that the groundwater in the studied regions is unsuitable for human consumption [5].

Exposure to elevated levels of fluoride in drinking water can lead to various health complications. Chronic fluoride intake has been linked to arthritis, causing joint pain, stiffness, and inflammation. It can also affect fertility in both men and women, contributing to infertility. Prolonged exposure to fluoride has been associated with hypertension, as it may raise blood pressure levels [6,7].

Children are particularly vulnerable to the adverse effects of elevated fluoride levels in drinking water. Due to their smaller body size, higher water intake relative to their weight, and developing systems, children are at greater risk for fluoride toxicity. Prolonged exposure to high fluoride concentrations can lead to dental fluorosis, characterized by discoloration and damage to the developing teeth [8]. In severe cases, it may also cause skeletal fluorosis,

leading to bone deformities and joint pain [9]. Moreover, cognitive and neurodevelopmental impairments such as reduced IQ, learning difficulties, and behavioral changes have been associated with high fluoride exposure [10]. Fluoride toxicity in children may also affect bone health, contributing to stunted growth and increased susceptibility to fractures [11].

Preventive measures to mitigate the risks of fluoride exposure, particularly in children, are crucial to safeguarding health. One of the most effective methods is the use of water filtration systems, such as reverse osmosis (RO) or activated alumina filters, which can significantly reduce fluoride concentrations in drinking water [8]. Regular monitoring of water fluoride levels and periodic health screenings for children, including checking for signs of dental fluorosis and skeletal fluorosis, are essential steps to detect and address potential health risks early [9]. Dietary interventions, such as ensuring adequate intake of calcium and vitamin D, can help counteract the harmful effects of fluoride on bone health and reduce the risk of skeletal fluorosis [6]. Encouraging the use of fluoride-free toothpaste for children in areas with high fluoride levels in drinking water can also minimize the risk of dental fluorosis [5]. Organic and controlled-release fertilizers are potential alternatives that are less likely to introduce high fluoride concentrations into the environment [12]. Precision farming is also known as site-specific crop management is another modern way of tacking this issue. It merges data collection and remote sensing with Global Positioning Systems (GPS) and Geographic Information Systems (GIS) to allow farmers to respond to in-field variability with their crop management [13].

In the context of fluoride contamination, the One Health approach highlights the shared risks faced by humans, animals, and the environment from elevated fluoride levels in drinking water and soil. Prolonged fluoride exposure can lead to significant health issues in humans. To address these challenges, a One Health approach would advocate for integrated strategies to manage fluoride exposure, such as the use of low-fluoride fertilizers, improved agricultural practices, soil remediation, and effective water treatment technologies. By adopting this holistic approach, we can minimize the harmful effects of fluoride contamination, ensuring the health and sustainability of ecosystems, livestock, and human communities and safeguard our children from the potential harmful effects.

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