Arsenic contamination in groundwater of the Majha belt of Punjab and its probable carcinogenic and non-carcinogenic health hazards

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Arsenic is widespread in groundwater in India. High levels of arsenic in the three districts of Amritsar, Gurdaspur and Tarn Taran (also called Majha belt) have caused a crisis in Punjab. According to the Indian Council of Agriculture Research report, 13 districts of Punjab have arsenic content beyond the safety limit. This study aims to estimate probable health hazards due to ingestion of water with high levels of arsenic in the groundwater of Majha belt. Analysis of groundwater samples done using inductively coupled plasma mass spectrometry were collected from the Department of Water Supply and Sanitation, Government of Punjab, Mohali. The highest arsenic contamination of 111 ppb was found in the groundwater of Amritsar district, followed by Gurdaspur and Tarn Taran districts. The average value of hazard quotient (HQ) for children and adults in Amritsar district is estimated to be 11.13 and 8.0 respectively. HQ values for all the 650 habitations surveyed in the Majha belt of Punjab are greater than 1, which is a matter of concern because of high-risk potential for developing adverse carcinogenic and non-carcinogenic health hazards. The predicted values for cancer induction in children and adults of Amritsar district are 500 and 360 per million respectively. Mitigation of arsenic in groundwater is an urgent need in the Majha belt of Punjab.

Keywords: Arsenic, cancer risk, groundwater, health hazards, mitigation.

An extensive study of arsenic contamination in groundwater of Indian and Pakistani Punjab was undertaken by the scientists of both countries in a collaborative research project funded by Columbia University, New York, USA[11]. However, there is no epidemiological study on health hazards of arsenic in the Majha belt of Punjab. To date, the source of arsenic contamination in Punjab groundwater is uncertain. We[5,7] along with other researchers[12–14] have reported high levels of arsenic beyond the permissible limit fixed by WHO (10 ppb) in groundwater of Punjab.

Arsenic is widely distributed as a metalloid in the environment (soil, water, air and rocks). It possesses characteristics of both a metal and a non-metal. Inorganic arsenic is the most prevalent in nature, and its high toxicity is the cause of major health hazards. It can react with oxygen or other molecules in the air, water or soil. It forms various

