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The magnitude of arsenic contamination in groundwater and its health effects to the inhabitants of the Jalangi—one of the 85 arsenic affected blocks in West Bengal, India

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Abstract

To better understand the magnitude of arsenic contamination in groundwater and its effects on human beings, a detailed study was carried out in Jalangi, one of the 85 arsenic affected blocks in West Bengal, India. Jalangi block is approximately 122 km^2 in size and has a population of 215 538. Of the 1916 water samples analyzed (about 31% of the total hand tubewells) from the Jalangi block, 77.8% were found to have arsenic above 10 $\mu g\ l^{-1}$ [the World Health Organization (WHO)-recommended level of arsenic in drinking water], 51% had arsenic above 50 $\mu g\ l^{-1}$ (the Indian standard of permissible limit of arsenic in drinking water) and 17% had arsenic at above 300 $\mu g\ l^{-1}$ (the concentration predicting overt arsenical skin lesions). From our preliminary medical screening, 1488 of the 7221 people examined in the 44 villages of Jalangi block exhibit definite arsenical skin lesions. An estimation of probable population that may suffer from arsenical skin lesions and cancer in the Jalangi block has been evaluated comparing along with international data. A total of 1600 biologic samples including hair, nail and urine have been analyzed from the affected villages of Jalangi block and on an average 88% of the biologic samples contain arsenic above the normal level. Thus, a vast population of the block may have arsenic body burden. Cases of Bowen's disease and cancer have

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been identified among adults who also show arsenical skin lesions and children in this block are also seriously affected. Obstetric examinations were also carried out in this block.

Keywords: Arsenic groundwater contamination; Jalangi block; Arsenical skin lesions; Population at risk; Arsenic in biologic samples; Arsenic toxicity in children; Obstetric outcome

1. Introduction

The contamination of groundwater from arsenic and its health impact on humans have already been reported from 23 regions in different part of the world. The magnitude of this problem is severe in Bangladesh (Chowdhury et al., 2000, 2001; Rahman et al., 2001; Smith et al., 2000; Roychowdhury et al., 1999; Van Geen et al., 2003) followed by West Bengal, India (Chakraborti et al., 2002; Rahman et al., 2003; Mandal et al., 1998; Guha Mazumder et al., 1992) and China (Sun et al., 2001; Xia and Liu, 2004). In recent years evidence of arsenic contaminating groundwater has also emerged in other Asian countries including: Lao PDR, Cambodia, Mayanmar and Pakistan (ESCAP-UNICEF-WHO Expert Group Meeting, 2001). Groundwater arsenic contamination and associated health effects have also been reported from Nepal (Tendukar et al., 2001; Shrestha et al., 2003), Vietnam (Berg et al., 2001), the Kurdistan province of Iran (Mosaferi et al., 2003) and Bihar state (Chakraborti et al., 2003) in the Middle Gangetic Plain in India. Recently with the discovery of arsenic in the groundwater in other states Uttar Pradesh, Jharkhand and Assam in India (Chakraborti et al., 2004) and combining with the previously reported arsenic contamination incident in northern India (Datta, 1976), West Bengal and Bangladesh it appears that some areas in all states and countries of India and Bangladesh in the Ganga–Meghna–Brahmaputra (GMB) plain, with population over 450 million and area 570 000 km^2, might be at risk from groundwater arsenic contamination (Chakraborti et al., 2004).

Arsenic contamination of the groundwater in West Bengal was first reported in 1984 (Garai et al., 1984; Chakraborti et al., 2002). We have been conducting analytical, clinical and epidemiological surveys in the arsenic affected areas of West Bengal since 1988 but we feel our present research may only be the tip of an iceberg representing the full extent of arsenic contamination in West Bengal. The area and population of arsenic affected districts of West Bengal are 38865 km^2 and 50 million, respectively. To date we have analyzed water samples from more than 129 000 hand tubewells from nine arsenic affected districts of West Bengal and our results show that 49.6% of the samples have arsenic above 10 μg l^{-1} and 24.7% above 50 μg l^{-1} (Chakraborti et al., 2004). On an average 78% of the 28 000 biologic samples including urine, hair, nail and skin-scale analyzed in arsenic affected villages of West Bengal have arsenic above the normal level (Chakraborti et al., 2004). We have also screened 92 000 people in the arsenic affected villages of West Bengal and 8900 were registered with various types of arsenical skin lesions (Chakraborti et al., 2004).

To understand better the status of arsenic contamination of groundwater and its impact on people's health we decided to study in details one of the 85 arsenic affected blocks of West Bengal. We randomly selected the Jalangi block of Murshidabad district as our study area. Our preliminary study appears to show that out of the 85 arsenic affected blocks of West Bengal, at least 30 are affected as severely as Jalangi.

In this article we describe (i) arsenic contamination status in groundwater of the Jalangi block and the number of people drinking arsenic contaminated water at various concentration levels, (ii) arsenicosis patients in Jalangi block, (iii) an estimation of population that may suffer from arsenical skin lesion and cancer in Jalangi comparing with international data, (iv) arsenic in biologic samples and population may be sub-clinically affected, (v) arsenic affected children in Jalangi and (vi) chronic arsenic toxicity and pregnancy outcome in Jalangi.