Groundwater arsenic contamination in selected area of Bihar

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ABSTRACT: Arsenic (As) is more concentrated near river plain of Bihar, like Ganga and Gandak rivers. It is not reported in places where fluoride content is high in ground water. The current study observed high As contents in the alluvial aquifer of Ganga basin, but no As in hard rock area away from Ganga like Banka district of Bihar.

1 INTRODUCTION

Arsenic (As) is an element, which is highly toxic in nature. The occurrence of As in ground water was first reported in 1980 in West Bengal in India. Groundwater is the main source of drinking water and constitutes about more than 80% drinking source in rural Bihar. The groundwater As contamination in Bihar was first reported in Semaria Ojha Patti village of Shahpur, a block of Bhojpur district in 2002 (Chakraborti *et al.*, 2003). So far, 17 of 37 districts and a total of 87 of 532 community blocks have been investigated for groundwater As contamination. Three community blocks were As safe, as all the sources tested in these blocks had As levels below the detection limit of the measurement method used (Ghosh *et al.*, 2009). Currently, the groundwater As contamination has spread to 16 districts, threatening more than 10 million people in Bihar (Ghosh *et al.*, 2007). Out of a total 240,000 water supply hand pumps (public and private) in As affected blocks of Bihar, only 27% (66,623) of the sources were tested for elevated As levels (Nickson *et al.*, 2007). The continuous consumption of As through drinking water and food sources may lead to As poisoning popularly known as ‘*Arsenicosis*’. The United States National Research Council has reported that, one in 10 people who drink water containing $500 \mu\text{g L}^{-1}$ of As may ultimately develop lung, bladder, and skin cancers. Arsenic health effects range from skin lesions to cancer at values from $10 \mu\text{g L}^{-1}$ to up to $2000 \mu\text{g L}^{-1}$ of As in drinking water.

2 METHODS

2.1 Study area

Samples (N=42) were collected from volunteers residing in As contaminated areas from Bhagalpur (Rannuchak and Nandgola), Banka (Rajpura and Kakna), Saran (Sabalpur), Patna (Haldi Chapara,

Maner) and Samastipur (hanssopur) districts of Bihar, India as a part of ongoing Nutri-SAM project.

2.2 Data collection

After taking informed consent, data on socio-economic, nutritional and health status were collected using questionnaire. Water sample were collected and As content was estimated by Atomic Absorption Spectrophotometer (PerkinElmer PinAAcle 900 T) using standard APHA protocol.

2.3 Analysis method of water

Sterilized bottles were used for collection of water sample in which 6–10 drops of 1% HNO_3 was added as preservative in each sample bottle. Water samples were collected after 10–15 minutes of flushing the hand pump. Sample bottle were filled up to neck. Samples were brought to lab and stored in refrigerator at 5°C . Arsenic content was analyzed by AAS.

Figure 1. Site visited during field study for water sample analysis.

Figure 2. Arsenic level in water samples.

Table 1. Summary of arsenic concentrations ($\mu\text{g L}^{-1}$).

Area	Mean	SEM	Maximum
Bhagalpur	38.79	13.75	99.47
Banka	00	00	00
Mener (Haldi Chapra)	26.88	7.527	50.62
Sonepur (Sabalpur)	38.62	14.09	107.1
Samastipur (Hanssopur)	38.74	35.96	254.5

2.4 Statistical analysis

Descriptive data as mean $\pm$ standard deviation along with comparison tests, association and correlations represented using Graph Pad Prism was done.

3 RESULTS AND DISCUSSION

3.1 Arsenic level in water samples

There were significant differences between As level in water of different study site. Mean $\pm$ SEM of As level in Bhagalpur was $38.79 \pm 13.75 \mu\text{g L}^{-1}$ ($n = 11$), mean $\pm$ SEM of As level in Maner (Haldi Chapra) was $26.88 \pm 7.53 \mu\text{g L}^{-1}$ ($n = 7$), mean $\pm$ SEM of As level in Sonepur (Sabalpur) was $38.62 \pm 14.09 \mu\text{g L}^{-1}$ ($n = 8$), mean $\pm$ SEM of As level in Samastipur (Hanssopur) was $38.74 \pm 35.96 \mu\text{g L}^{-1}$ ($n = 7$).

High As concentration was observed at 50 to 140 ft depth, while groundwater samples below 250 ft had no As in this area. There was no significant difference in

demography and nutrient intake between participants. Skin pigmentation and keratosis were reported in low socioeconomic people residing in these areas, while with high socio economic status have little or no symptoms, which indicates that nutritional supplement has a great role in detoxification of As toxicity.

4 CONCLUSIONS

It is concluded from study that As is more concentrated near river plain of Bihar, like Ganga and Gandak rivers. It is not reported in places where high fluoride content is reported for example Banka district but has no As.

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