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Fate of Arsenic in Belhari Block: Arsenic Affected Endemic Area of Belahri District, India

Neha Chaurasia[1], Devendra Mohan[2], S.K.Pandey[3] and G.P.Singh[3]
[1]Department of Forensic Medicine, Institute of Medical Sciences, Banaras Hindu University, Varanasi, UP, INDIA
[2]Department of Civil Engineering, IIT, Banaras Hindu University, Varanasi, UP, INDIA
[3]Deptt. of Community Medicine, Institute of Medical Sciences, Banaras Hindu University, Varanasi, INDIA

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Abstract

This paper presents a study health impact of Arsenic contaminated ground water used for drinking in Rajpur Ekhuna, Haldi, Name Chhapra and Gangapur villages in Belhari development block in Belahri district, situated in Eastern Uttar Pradesh. The study area is located at bank of the river Ganga and it characterized by alluvial fans and alluvial terraces, flood-plain with boulders, gravel, conglomerate, etc. Out of total 50 samples analyzed, 94% had Arsenic above 10 µg/L (WHO provisional guideline value), 34% between 10 and 50 µg/L, 60% above 50 µg/L (Indian standard for Arsenic in drinking water) and 18% above 250 µg/l of Arsenic. It was found that none of the samples were safe according to the WHO guideline value. Arsenic concentration was relatively more in Rajpur Ekhuna and Gangapur than that in other villages. The exposed population is suffering from many Arsenic- related diseases and also from social exclusion due to the menace of diseases.

Keywords: Deterioration, alluvial terraces, alluvial fans, social exclusion, menace of diseases, degradation.

Introduction

This paper presents a study health impact of Arsenic contaminated ground water used for drinking in Rajpur Ekhuna, Haldi, Name Chhapra and Gangapur villages in Belhari development block in Belahri district, situated in Eastern Uttar Pradesh. The study area is located at bank of the river Ganga and it characterized by alluvial fans and alluvial terraces, flood-plain with boulders, gravel, conglomerate, etc. Out of total 50 samples analyzed, 94% had Arsenic above 10 µg/L (WHO provisional guideline value), 34% between 10 and 50 µg/L, 60% above 50 µg/L (Indian standard for Arsenic in drinking water) and 18% above 250 µg/l of Arsenic. It was found that none of the samples were safe according to the WHO guideline value. Arsenic concentration was relatively more in Rajpur Ekhuna and Gangapur than that in other villages. The exposed population is suffering from many Arsenic- related diseases and also from social exclusion due to the menace of diseases.

Keywords: Deterioration, alluvial terraces, alluvial fans, social exclusion, menace of diseases, degradation.

Taking into consideration the advancements (bio-medical and technological), social and political ecology, the relationship between infirmity and human health is as old as human civilization and its nature has changed with time. There is growing epidemiological research evidence that there is a great co-relationship between health and various socio-economic and environmental over burdened health care facilities in the developing countries in general and India in particular.

Arsenic in drinking water has been linked to multiple health problems, including bladder, lung, and skin cancers; cardiovascular disease; diabetes; and neurological dysfunction National Research Council, 1999[1]. In recognition of the health risks associated with Arsenic, the U.S. Environmental Protection Agency USEPA[2] decreased the Maximum Contaminant Level (MCL) for Arsenic from 50 to 10µg/L on October 31, 2001 U.S. Environmental Protection Agency, 2001. The new MCL will be enforceable for public water systems nationwide in 2006. In India permissible limit is 50ppb.

The first global study on hazardous heavy metals identifies nearly one among a dozen hot spots in India. As per this report heavy metal pollution is the highest in Asia, which is impacting the health of the people as well as wild life Sad Ahmad, 2006[3].

The study area is a part of the Indo-gangetic plain which is formed of alluvium of quarternary age[4]. The area is situated very close to the bank of the river Ganga and very prone to floods and water logging. The damage is obviously more severe in almost every year. Water quality of the region plays an important role in the overall water balance of the environment. Polluted groundwater is the cause for the rampancy of epidemies and chronic diseases in residing population. A large number of people have been dying because of Arsenic born diseases. These villages are such ones. During 2011, Ground water samples were drawn from 50 domestic wells at sites in Pre-monsoon season. The study area includes four sites in Belhari block, namely Rajpur Ekhuna, Haldi, Gangapur and Name Chhapra villages which are near the bank of Ganga and

are very prone to floods and water logging. The damage is obviously more severe in almost every year. The study is based on the primary data and experimental work (Arsenic conc.). For the study, relevant questionnaires schedule were prepared to collect various information related to, socioeconomic status, water related problems and their impact on residing population. The area is very rich in agricultural and rural inhabitation.

Material and Methods

Method: A total of 50 samples were tested using Digital Arsenator make[5]. It uses an optical photometer to measure the colour change on mercuric bromide filter paper. It is portable and detects Arsenic in a range of 2-100 ppb.

A recent UNICEF commissioned study from India comparing the Arsenator with laboratory AAS-HG showed a very high correlation of 0.998 Shriram Institute, 2006[6]. Wagtech also produces a Visual Arsenic Detection Kit, which uses a visual reference colour chart instead of the optical photometer. It has a reported range of 10-500 ppb.

Results and Discussion

Concentration of Arsenic above in the study areas: This contamination has been found mainly due to geographic. Based on 50 water samples analysis from four villages of Belhari Block, table-1 shows that distribution of tube-wells with different Arsenic concentration ranges. Of the total samples 94% had Arsenic above 10µg/L (WHO provisional guideline value), 34% between 10 and 50µg/L, 60% above 50µg/L Indian standard for Arsenic in drinking water[9] and 18% above 250µg/L of Arsenic. During testing we found that none of the samples were safe according to the WHO guideline value. Arsenic concentration was relatively more in Rajpur Ekhuna and Gangapur rather than other villages. Arsenic concentration in ground water was not uniformly distributed in any part of the area and high Arsenic concentration was usually found in isolated patches.

Table-1
No of samples (%) and their concentrations

Concentration	No of samples (in Percentage)
0-10PPb	6.00
>10-50PPb	34.00
>50-250PPb	42.00
>250-Above	18.00

The influence of depth of hand pumps on the Arsenic concentrations of 50 samples is shown in table-2, however the less depth hand pumps have a higher chance of contamination. The result shows that the depth and Arsenic concentration change in opposite directions, it means the correlation is negative through the magnitude of the correlation (-0.497) approximately equal to -0.50 and it is statistically significant at the 0.01 level and 99% confidence interval.

Figure-1
Digital Arsenator Produces by Wagtech International Ltd

Table-3 shows correlation between Arsenic concentration and oldness of drinking sources. Concentration increases the increase number of the oldness of hand pipe it means both move in the same direction. It means the correlation is positive through the magnitude of the correlation (0.54) and it is statistically significant.

At initial level Arsenics concentration is high as the depth of hand pump is low. The increase in the depth of hand pumps causes decrease in Arsenic concentration but the decreased was not gradual, as it is shown in figure-2. Depth and Arsenic concentration varies from place to place Maximum concentration found at 100-150 feet.

Demographic profile of target population in table-4 shows that 40% studied households contains at least 6-10 family members in particular. On the behalf of education 90% respondents are educated, only 10% are illiterate; out of 90% educated we found that 60% are above intermediate. These studies clearly show that most of the families belong to agriculture (78%), they are from social weak backgrounds, and these people are more affected by Arsenic-related diseases than others. In these studies we found more interesting data about awareness, education and family occupation, most of the population are educated and aware about the present Arsenic situations but they are very poor, so they do not afford better mitigation techniques. Prevalence of skin lesions is higher among men than women, as the prevalence of skin disease is higher when the populations are exposed to concentrations of Arsenic above 50 µg/l in their drinking water.

Epidemiological study, to establish prevalence rates, reflects that about 42% household contains at least 2 persons, which are suffering for skin lesions and consume 50 ppb Arsenic concentration. Women are more socially damaged than men by Arsenic related illnesses; most of them are victim of social exclusion. Other results: Diffused melanosis (darkening of skin) in the body or palm is the earliest sign found on subjects. Spotted pigmentation is usually seen on chest back or limbs. Leucomelanosis is also seen on many patients. Diffuse with modular keratosis on palm and sole is a sign of moderately severe toxicity. Rough dry skin often with palpable nodules in dorsum of hands, feet and legs are the symptoms seen in some cases.

It was seen that persons who have stopped drinking Arsenic contaminated water, got relief. Many exposed persons lose their jobs due to widespread fear of disease mania, most severe in poor people.

Table-5 shows that number of household aware about Arsenic and depth of hand pump, mean and standard deviation are shows strong correlation between them.

Table-2
Correlation between Arsenic concentration, depth of hand pump and distance from the River Ganga

Variable	Spearman Test	Arsenic Concentration (ppb)	Depth of Hand pump (ppb)	Distance from Ganga (ppb)
Arsenic concentration	Correlation Coefficient	1.000	-0.497**	0.150
	Sig. (2-tailed)	0.0	0.000	0.299
	N	50	50	50
Depth of hand pump	Correlation Coefficient	-0.497**	1.000	0.014
	Sig. (2-tailed)	0.000	0.0	0.926
	N	50	50	50
Distance from ganga	Correlation Coefficient	0.150	0.014	1.000
	Sig. (2-tailed)	0.299	0.926	0.0
	N	50	50	50

** Correlation is significant at the 0.01 level (2-tailed)

Table-3
Relation between Arsenic concentration and oldness of drinking water sources

Variable	Spearman	Arsenic concentration	Oldness of drinking water source
Arsenic concentration	Correlation coefficient	1.000	0.538**
	Sig. (2-tailed)	0.0	0.000
	N	50	50
Oldness of drinking water source	Correlation coefficient	0.538**	1.000
	Sig. (2-tailed)	.000	0.0
	N	50	50

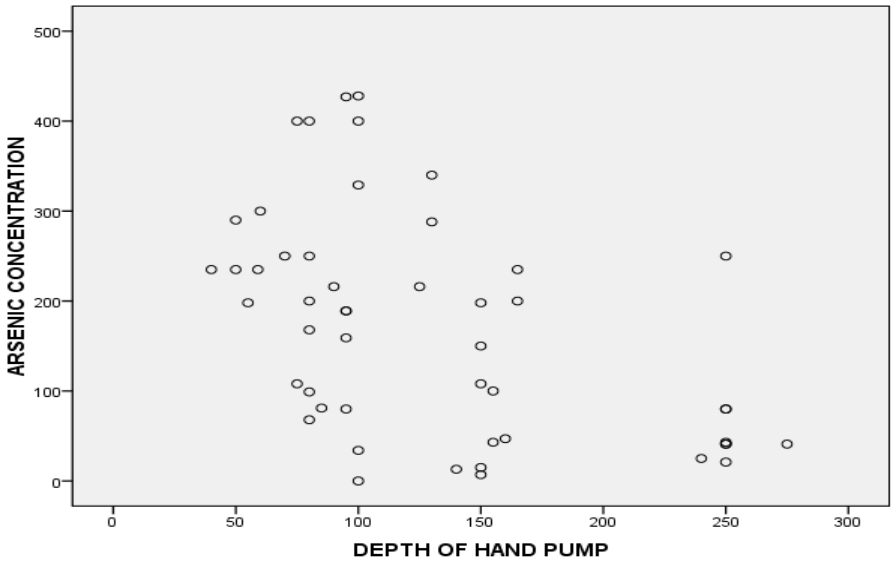

Figure-2
Correlation between Arsenic concentration and Depth of hand pump[5]

Table-4
Demographic representation of Belhari Block

Demographic Profile of Belhari Block		
Variable	**Frequency**	**Percentage**
No. of Member in Family		
0-5	3	6.00
6-10	20	40.00
11-15	12	24.00
16-20	10	20.00
>21	5	10.00
Educational qualification of the respondent		
Illiterate	5	10.00
Lower than 12 Standard	15	30.00
12 Standard -Graduation	25	50.00
Higher than graduation	5	10.00
Source of Income		
Agriculture	39	78.00
Business	6	12.00
Others	5	10.00
Number of patients suffering from related skin diseases		
No. of patient	**No. of family**	**Percentage of Patients per Family**
0-2	21	42.00
3-5	16	32.00
6-8	8	16.00
>8	5	10.00

For this study, a (50) household has use as a sampling unit as shown in table-6., Household (36) using water with Arsenic concentration above 50 ppb is defined as risk household (72%) and all the family member consuming high Arsenic concentration water is consider as risk population (26.56%)at total household population which is 625 (target population).

Table-5
Statistical analysis of awareness about Arsenic and depth of hand pump

Awareness about Arsenic	Depth of hand pump			
	N	**Mean**	**Std. Deviation**	**Std. Error Mean**
Yes	36	142.47	67.462	11.244
No	14	98.21	53.335	14.254

Conclusion

All the existing 50 samples were analyzed for Arsenic. The distribution of Arsenic concentrations indicates that none of the sample was safe according to the WHO guideline; result shows that Rajpur Ekhuna village is highly Arsenic contaminated area, which is very near to Ganga. The ground water sampled range were 50 to 275 feet deep, and Arsenic concentrations greater than the MCL were detected over the entire range of depths. The highest Arsenic concentration (428µg/L) was from intermediate-depth wells (100 and 150 ft). For the dataset as a whole (N=50), there was significant correlation between Arsenic concentrations and well depth, these studies concludes that about 26.56% populations is at risk out of total target population (625). In studies we found more interesting data about awareness, education and family occupation, most of the respondent are educated and aware about present Arsenic situation but they are very poor, so they can't afford better mitigation techniques. Out of 50 interviews taken only 3 respondents are female, it represents male dominant society.

Table-6
Number of risk households out of total studied (N-50) households

Total Household	Risk Household	Percentage Risk Household (%)	Target Population	Risk Population	Percentage Risk Population (%)
50	36	72	625	166	26.56

The study indicates that the high concentration of Arsenic in ground water poses health deterioration of residing population. The study has also included the various facts like depth; distance and awareness about Arsenic also influence the severity of diseases. Residing population is suffering for many Arsenic related diseases. They are suffering from social exclusion due to menace of diseases. They do not have any feasible and economically viable option to mitigate the problem.

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