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Effect of Arsenic in Drinking Water of Biraul Block in Darbhanga District of Bihar

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ABSTRACT : Water is one of the prime natural resources and is called matrix of life. It is an essential part of all living systems and is the medium from which life evolved and in which life exists. About 3/4th of the earth's surface is covered with water. Groundwater is a major source for drinking water in both urban and rural areas all over the world. The major cause of concern all over the world including India is the contamination of groundwater resource by this toxic element. Since decades, in various countries people have been and still are exposed to inorganic arsenic through geo-genically contaminated drinking water. More recently arsenic contamination of ground water has also been found in some parts of Bihar. The hazardous effect of environmental arsenic on human health can be devastating and is an important issue. Long-term exposure to arsenic in drinking-water is causally related to increased risks of cancer of the skin, lungs, bladder and kidney, as well as other skin changes such as hyperkeratosis and pigmentation changes.

KEYWORDS : Groundwater, Hazardous, Arsenic, Human and Health.

I. INTRODUCTION

Water is one of the prime natural resources and is called matrix of life. It is an essential part of all living systems and is the medium from which life evolved and in which life exists. About 3/4th of the earth's surface is covered with water. For development of healthy society, quality of water has great significance. Deterioration in quality of water due to pollution is a global problem. Polluted water is source of many diseases for human beings as well as animals (Nag,2006).

Groundwater is a major source for drinking water in both urban and rural areas all over the world. The major cause of concern all over the world including India is the contamination of groundwater resource by this toxic element. Since decades, in various countries people have been and still are exposed to inorganic arsenic through geo-genically contaminated drinking water. More recently arsenic contamination of ground water has also been found in some parts of Bihar. The hazardous effect of environmental arsenic on human health can be devastating and is an important issue. Long-term exposure to arsenic in drinking-water is causally related to increased risks of cancer of the skin, lungs, bladder and kidney, as well as other skin changes such as hyperkeratosis and pigmentation changes.

These effects have been demonstrated in many studies using different study designs. Exposure-response relationships and high risks have been observed for each of these end-points. Increased risks of lung and bladder cancer and of arsenic-associated skin lesions have been reported.

Safe drinking water is a fundamental human right and it is the basic need of individuals. Over the past three decades, occurrence of high concentration of arsenic in the groundwater has been recognised as a major public health concern in several parts of the world including India. Seventy countries have been recently identified as arsenic affected areas and it is likely that many other areas with elevated arsenic in groundwater will be found in the future.

Arsenic is abundant in the crust of the earth and is found in all environments. It is found in soil, minerals and groundwater in various forms. Arsenic in the groundwater exists primarily as oxy anions representing two oxidation states: arsenite (As III) and arsenate (As V). Both exist within the pH range of 6-9. It is well-established fact that arsenite (As III) is more toxic than arsenate(As V). World Health Organization (WHO) estimates that more than 200 million persons worldwide might be chronically exposed to arsenic in drinking water at concentrations above the WHO safety standard of 10 µg/L.

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The entire Gangetic plain of India-the upper Ganga plains, the middle Ganga plains and the lower Ganga plains are the areas with very high population density, the land here is highly fertile and agriculture is the main occupation and source of income of the rural population. Groundwater is the main source of drinking, cooking, agriculture and other household purposes. Bihar and West Bengal are located within the Middle-Ganga Plains (MGP) and are the two worst arsenic contaminated states in India. Presently, about 18 districts of Bihar are affected due to arsenic contaminated groundwater. It is estimated that more than 5 million people in the Bihar state are drinking water with arsenic concentration greater than the permissible limit i.e., 10 µg/L. Majority of the affected population belong to rural areas and economically very poor. Population of these areas are still drinking arsenic contaminated groundwater and are not aware of this fact. The arsenic exposed population are serious issue which aggravates impact of arsenic on their health. The continuous consumption of elevated arsenic through drinking water (more than five years) may lead to arsenic poisoning.

The Darbhanga district of Bihar is situated between latitude N25O53'26.27", longitude E85O45'25". Its average distance is 80 km away from the northern bank of river Ganges and its geographical area is 2,279 sq. km. The total population of the district is 39,21,971 (Census 2011). First incidence of arsenic contaminated groundwater was reported from Biraul block of Darbhanga districts in 2005. The incidence of groundwater arsenic contamination was increased at a high rate in several districts of Bihar in last decades and previous studies suggest that arsenic contamination is most prevalent in rural areas. Therefore, present study was undertaken in four villages under Biraul block of Darbhanga district to know the prevalence of arsenic concentration in groundwater.

Location :

The present study was carried out in four villages under Biraul block of Darbhanga district. Pokhram is a large village located in Biraul Block of Darbhanga district, Bihar with total 5483 families residing. The Pakhram village has population of 28209 of which 14891 are males while 13318 are females as per Population Census 2011(26.322 and 86.2082) and Paghari is a large village located in Biraul Block of Darbhanga district, Bihar with total 854 families residing. The Paghari village has population of 4163 of which 2125 are males while 2038 are females as per Population Census 2011 (26.2205 and 85.8188), Rohar is a village situated in Biraul block of Darbhanga district in Bihar. As per the Population Census 2011, there are total 3,656 families residing in the village Rohar. The total population of Rohar is 17,506 out of which 9,160 are males and 8,346 are females thus the Average Sex Ratio of Rohar is 911 (26.17 and 85.9) and Akbarpur Baik is a village situated in Biraul block of Darbhanga district in Bihar. As per the Population Census 2011, there are total 1,178 families residing in the village Akbarpur Baik. The total population of Akbarpur Baik is 6,329 out of which 3,343 are males and 2,986 are females thus the Average Sex Ratio of Akbarpur Baik is 893.

II. REVIEW OF LITERATURE

Review of selected literature is an essential part of every research process. It helps us to examine and evaluate what has been said earlier on the research subject.

Guha, Mazumder, D.N et.al. (1988) The term arsenicosis to designate human health effect of chronic arsenic toxicity was first coined by our group and later used by the World Health Organization to imply a chronic disease caused by prolonged exposure of arsenic in humans. Previously, the condition was described as arseniasis, arsenism, arsenicism, and others.

IARC (2004) Several studies have investigated the genotoxic effects of arsenic after long-term exposure in drinking water. Increased incidence of chromosomal aberration and frequency of micronuclei in buccal and urothelial cells was observed by many workers after drinking of arseniccontaminated water.

Guha, Mazumder, D.N et.al. (2001) High incidence of weakness and fatigue have been reported in chronically arsenic-exposed people after drinking arseniccontaminated water in West Bengal and in many other countries

Saha, K.C. & Saha's (2003) In West Bengal, 212 (4.35%) cases of skin cancer and 38 (0.78%) cases of internal cancers were detected among 4,865 cases of arsenicosis studied in arsenic-affected villages.

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NRC (National Research Council) (1999) A characteristic pattern of anemia, leucopenia, and thrombocytopenia was found in 55 participants exposed to arsenic in drinking water in Niigata Prefecture in Japan for approximately 5 years, half of the patients having arsenical skin lesions

Material and Methods :

Collection of samples: The water sample bottles (250 ml polypropylene bottle) were well cleaned and pre-treated with 1% hydrochloric acid. Altogether, 48 groundwater samples (12 groundwater samples from each village) were randomly collected in duplicates from hand tube wells (HTWs) of the households situated at every 50 meter of distance in the villages. One liter of water samples were collected from each hand pump in sterile clean conc. HCl added bottle so that pH of water reduced upto 1-2 (AHPA, 1995). The suspected people of the villages were exclusively interrogated and examined for arsenic related diseases to know their health status. For this a questionnaire method was utilized and health related data were extensively collected. The survey work was carried out in the months from January to May 2018.

III. RESULTS

Groundwater arsenic assessment :

Groundwater analysis of all the 48 samples collected from the four villages represented high prevalence of arsenic contamination. The highest arsenic concentration recorded in the groundwater sample was 911 $\mu\text{g/L}$ from Paghari village. Overall maximum arsenic concentration recorded in the groundwater samples of all the four villages were 911 $\mu\text{g/L}$ in Paghari, 201 $\mu\text{g/L}$ in Rohar, 843 $\mu\text{g/L}$ in Pokharam, 862 $\mu\text{g/L}$ in Akbarpur Baik respectively.

Health assessment:

Altogether 500 subjects (125 subjects from each village) were interviewed during health assessment. Many villagers exhibited typical symptoms of arsenicosis like leuco-melanos. Blackening of teeth and nails were also observed in many persons of the arsenic exposed population. Few of them exhibited hyperpigmentation (spotted pigmentation) on their whole body. Apart from typical symptoms of arsenicosis, other health related problems like gastrointestinal, liver, neurological disorder and hormonal imbalance were frequently observed. Incidence of cancer especially skin, liver and breast were frequently observed in Paghari village. The interviewed persons reported that many people died of cancer in last two decades.

IV. DISCUSSION

Groundwater arsenic poisoning in the Middle Gangetic Plain of Bihar, India, was identified in July 2002, in Semaria Ojhapatti village of Shahpur block of the Bhojpur district. First incidence of arsenic contaminated groundwater was jointly reported by two government agencies in only one block of Darbhanga district in 2005. The concentration of arsenic in the groundwater at that time was not much higher as compared to the other districts of Bihar residing near the bank of the river Ganga. Incidence of groundwater contamination and its adverse effect on health in the population of state Bihar increased at a higher rate. Presently 18 districts of Bihar state are under threat of arsenic poisoning and majority of districts belongs to the nearer areas of bank of the river Ganges.

After a decade, in the present study four villages of Darbhanga district showed very high contamination of arsenic poisoning in the Groundwater of their hand pumps. 911 $\mu\text{g/L}$ is the maximum observed value of total arsenic reported from Paghari village of Biraal block which is much higher than the permissible limit. Detection of elevated arsenic in the groundwater from villages of Darbhanga district which is located about 80 km north of the river Ganga, indicates that contamination may be spread even to areas far off from the river Ganga. Geographical parameters like shifting of water table downwards, leaching of toxic chemicals in the groundwater and over exploitation of groundwater are the suggested regions of arsenic elevation in the groundwater far from river Ganga.

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V. CONCLUSION

The results of the present study revealed that Biraul block of Darbhanga district possess both high and low arsenic containing ground water which is a matter of further study. Our results confirm the presence of arsenic in groundwater in many parts of the Darbhanga district. In several samples, higher amount of arsenic was found which may cause serious health problems in people while drinking such water for a long time. There is need to make public aware of health problems due to arsenic poisoning and also the immediate need of remedial measures for providing safe drinking water in the areas where water contains arsenic above the permissible limit as set by WHO.

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