



# ORIGINAL RESEARCH PAPER

## Environmental Science

### HAEMATOLOGICAL STUDY OF ARSENIC EXPOSED POPULATION OF BHOJPUR DISTRICT OF BIHAR

**KEY WORDS:** Arsenic, RBC, haemoglobin and human subjects

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#### ABSTRACT

In the Indian subcontinent, the ground water poses a major threat of exposing animals and human beings to toxic level of arsenic in some geographical locations. High arsenic levels in groundwater have also been reported in some areas in Bhojpur district of Bihar and number of deaths have been recorded due to arsenic poisoning. The present study aims to assess the haematological parameters in blood samples of the village people of arsenic hit areas of Bhojpur district of Bihar. The study was conducted on 100 volunteers (51 male & 49 female) of arsenic hit area of Bhojpur district. The present observation showed that arsenic did not had any adverse effect on haemoglobin, however arsenic exposure reduced the RBC level in male & female both. The level of PCV, MCV, MCH & MCHC were also altered in the study.

#### INTRODUCTION

Arsenic (As) level beyond permissible limits in drinking water is the main cause of arsenic toxicity in the world. More than 20 Country, including India, is in the midst of a large scale threat cause by chronic mass toxicity through arsenic contamination of ground water. However the largest number of people in the world affected by chronic Arsenic toxicity due to drinking of arsenic contamination ground water belongs to Bangladesh, India and China.

In India investigations by Central Ground Water Board (CGWB) reveals that arsenic contamination ( $>0.05$  mg/L) is affecting the states of West Bengal, Bihar, Uttar Pradesh, Assam, Chhattisgarh. The Bengal Delta Plain (BDP) covering Bangladesh and West Bengal in India is the most severe case of groundwater arsenic contamination. Besides this high Arsenic ground water has also been reported from Jharkhand and Manipur state. In Bihar, arsenic poisoning was initially detected in the year 2002 from Semariya-Ojhapatti villages of Bhojpur district. The 57 blocks, in 18 districts of Bihar are under high arsenic contamination risk. Detailed investigations in the Gangetic Plain of Bihar revealed its wide occurrence on both the banks of the river Ganga (Chakraborty et al., 2002; Chakraborty et al., 2006; Chowdhury et al., 2000 & 2001).

Arsenic has a tendency to bind to the erythrocyte membrane via sulfhydryl group which is indicated by the decrease of the sulfhydryl level of membrane proteins (Zhang et al., 2000). The binding to the membrane induces changes in the fluidity of the membrane lipids and in the negative charge density in the outer surface of the membrane affecting the transport-system across it. In Wistar rats chronic inorganic arsenic administration reduced the Mean Corpuscular Volume (MCV) of red cells affecting the overall health status (Schulz et al., 2002). In wistar rats, arsenic (V) administration at the level of  $5 \mu\text{g}/10 \text{ gm}$  of food for 10 weeks increased plasma cholesterol level from  $47.27 \text{ mg/dl}$  to  $96.83 \text{ mg/dl}$  (Aguilar et al., 1997). The sodium arsenite administration ( $20 \text{ mg/kg}$  body weight) resulted in increased serum glucose level and serum aspartate aminotransferase activity but significant decrease in activity of alkaline phosphatase and lactate dehydrogenase was observed. Thus, the arsenic affects various physiological processes by numerous complex mechanisms.

Since, arsenic poisoning through ground water is causing lot of health hazards in the population of Bihar. Therefore, the present study aims to assess the haematological parameters in blood samples of the village people of arsenic hit areas of Bhojpur district.

#### MATERIALS AND METHODS

**Ethical Approval :** The ethical approval was obtained from the Post Graduate Research Council (PGRC) of the Veer Kunwar Singh University, Ara, Bhojpur, Bihar.

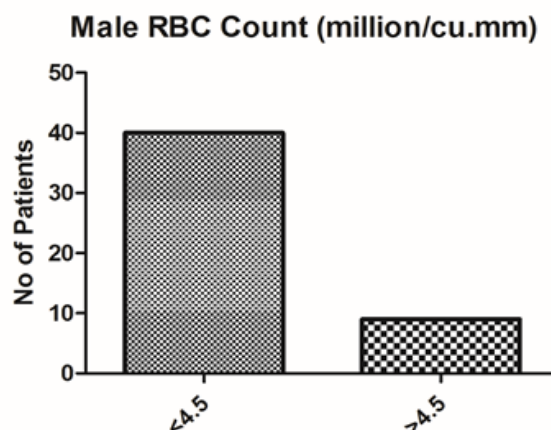
**Collection of Blood:** The blood samples from the peripheral venous were drawn from the 100 volunteers (51 male & 49 female) of the village from arsenic hit area of Bhojpur district. The blood samples were collected in EDTA vacutainer and were labelled and stored at  $4^\circ\text{C}$  for haematological study.

**Haematological Evaluation:** The haematological parameters Red Blood Cell Count (RBC's), Haemoglobin percentage (HGB) and RBC indices like Haematocrit (HCT), Mean Cell Volume of RBC's (MCV), Mean Cell Haemoglobin (MCH), Mean Cell Haemoglobin Concentration (MCHC) were analysed as per the protocols.

**Statistical Analysis:** Results are presented as mean  $\pm$  SD and total variation present in a set of data was analysed through one way analysis of variance (ANOVA). Difference among mean values has been analysed by applying Dunnett's t-test. Calculations were performed with the Graph Pad Prism Program (Graph Pad software, Inc., San Diego, U.S.A.). The criterion for statistical significance was set at  $P < 0.05$ .

#### RESULTS:

The present investigation was aimed to evaluate the deleterious affect of arsenic on human health with respect to haematological parameters – male and female RBC counts, male and female haemoglobin percentage, male and female RBC indices (Figure 1-6). The study was conducted on 100 volunteers (51 male & 49 female) of arsenic hit area. The affect of arsenic exposure on haematological parameters was observed in Bhojpur district of Bihar.



**Figure 1 .The data are presented as mean  $\pm$  S.D, n = 6, significance at  $P < 0.0001$ .**

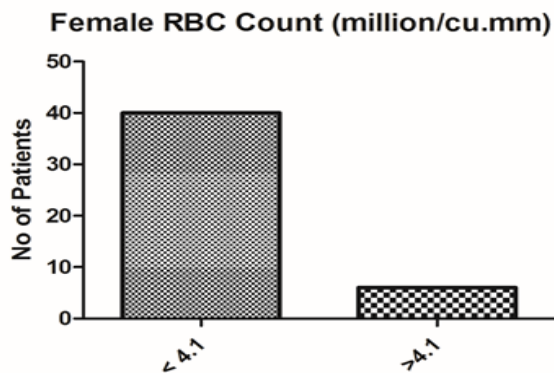


Figure 2 .The data are presented as mean  $\pm$  S.D, n = 6, significance at  $P < 0.0001$ .

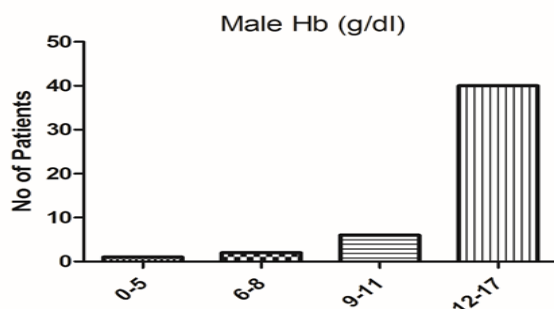


Figure 3 .The data are presented as mean  $\pm$  S.D, n = 6, significance at  $P < 0.0001$ .

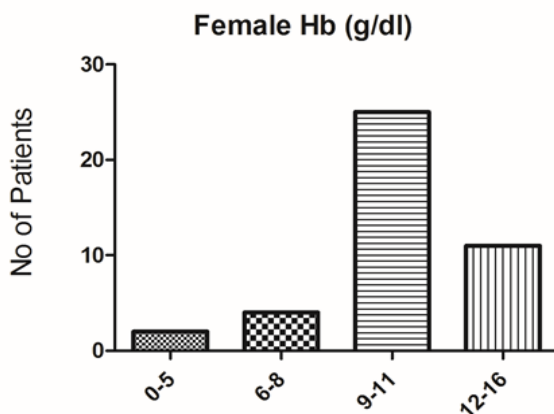


Figure 4 .The data are presented as mean  $\pm$  S.D, n = 6, significance at  $P < 0.0001$ .

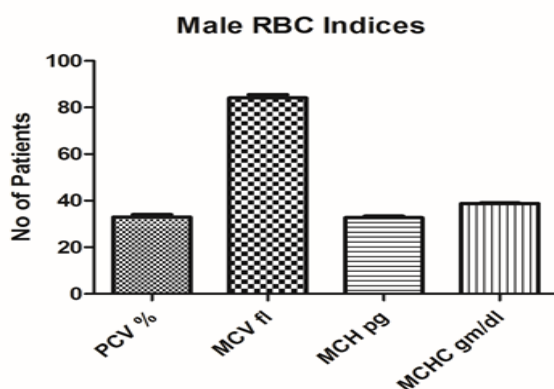


Figure 5 .The data are presented as mean  $\pm$  S.D, n = 6, significance at  $P < 0.0001$ .

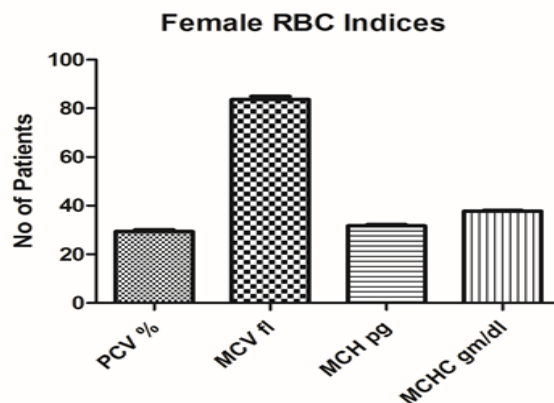


Figure 6 .The data are presented as mean  $\pm$  S.D, n = 6, significance at  $P < 0.0001$ .

#### DISCUSSION :

The haemoglobin (Hb) level in blood determines the oxygen carrying capacity of blood. Hb value below normal range significantly reduces oxygen carrying capacity and the anaemic condition may lead to anorexia, depression and stunted growth. In the present investigation Hb were done on 100 volunteers (51 male & 49 female) of arsenic hit area. The Hb were observed normal with range of 12-17gm/dl in 40 males and low Hb were observed 5-7 males with the range of 5-10gm/dl whereas in females normal Hb were observed in 12 females with the range of 12-16gm/dl and average Hb were observed in 20 females with the range of 9-11gm/dl however low Hb were observed in 8 females with the range of 5-7gm/dl.

Singh *et.al.*, (2001) reported that average level of arsenic in blood (mg/l) ranged from 0.0 to 0.525 in Ghentugachi and from 0.087 to 0.779 in cattle of Gontra village of Nadia district which are reported as As affected region in West Bengal. Higher blood arsenic concentration might be due to the fact that 95-99% of absorbed binds to globin of Hb in erythrocytes (Satake *et.al.*, 1997). Swenson and Reece, (1996) revealed no statistical difference due to treatment. However, the values observed in both the groups were slightly lower than the normal values. On the contrary, Satake *et.al.*, (1997) observed that chronic toxicity of As resulted in destruction of red blood cells and bone marrow cells, thus leading to anaemia, but in my study no such observations were recorded.

The present study observed low RBC level in 40 males (<4.5 cumm) and normal 10 males only (> 4.5 cumm) where as low level of RBC among females were also observed in the present investigation. The level of PCV, MCV, MCH & MCHC were also observed altered in male and female both.

Schulz *et.al.*, (2002) reported reduced Mean Corpuscular Volume (MCV) of red cells in wistar rats when subjected to chronic inorganic arsenic (NaAsO<sub>2</sub>) administration at the level of 2-6 mg/kg body wt. However, no studies are available on ruminants.

Shah *et al* 2004 noticed decrease in hemoglobin, RBC count and PCV values in *Tinca tinca* exposed to mercury and lead salts. Decrease in RBC count, hemoglobin, and PCV values were also noticed in *Nile tilapia* exposed to the pesticide edifenphos. Decreased rate of production of red blood cells or an increased loss of these cells in arsenic exposed *C. batrachus* might be the main reason for hemoglobin depletion. According to Reddy and Bashamohideen (Reddy *et al* 1989),

Atamanalp, *et al* 2003 and Patnayak *et al* 2006 also observed decrease PCV following exposure to various pesticides. PCV value also decreased in *C. striata* exposed to ammonia and lead (Devi *et*

al 2007). MCHC measurement is a diagnostic tool to assess the amount of RBC swelling (decreased MCHC) or shrinkage (increased MCHC) (Milligan et al 1989).

Mondal et al., 2012 in his experimental observations has well indicated the positive cooperative binding pattern of trivalent arsenic with Hb. The chronic arsenic exposure modifies the conformation of Hb such that two functions occur simultaneously – as comparatively weak binding of molecular oxygen to diseased Hb and strong binding of trivalent arsenic with the same Hb. This differential binding aspects of structurally and functionally modified Hb plays the vital role in developing disease pathogenesis in chronic arsenic toxicity. The work also illustrates that binding with arsenicals and increased oxidative stress significantly alters the structure and functional activity of Hb, indicating a pathway through which arsenic can exert its toxicity. Hb is a crucially tuned protein and any deviation in its structure–function properties must have its implications to be reflected in the pathogenesis of chronic arsenic toxicity (Bhattacharyya et al., 1998 & 2007; Biswas et al., 2008; Blair et al., 1990).

## CONCLUSIONS

The present study was conducted on 100 volunteers of arsenic hit area of Bhojpur district of Bihar to evaluate the effect of arsenic exposure on haematological parameter. Thus in the light of present investigation we can conclude that arsenic did not have any adverse effect on haemoglobin however arsenic exposure reduced the RBC level in male & female both. The level of PCV, MCV, MCH & MCHC were also observed altered.

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**Conflict of interest:** The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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