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Clinical and Socio Demographic Profile of Arsenicosis Patients in West Bengal. An Observational Study

D N Guha Mazumder[1], Kunal K Majumdar[2], Aloke Ghosh[3], Nilima Ghosh[4], Chandan Saha[5], Ashoke Nandy[6]

[1]Director, DNGM Research Foundation, Kolkata.
[2]Professor, Department of Community Medicine, KPC Medical College & Hospital, Jadavpur, Kolkata, India.
[3]Senior Research Fellow, DNGM Research Foundation, Kolkata, India
[4]Research Associate, DNGM Research Foundation, Kolkata, India
[5] Assistant Professor, Department of Clinical and Experimental Pharmacology, School of Tropical Medicine, Kolkata, India.
[6]Chemist, Department of Clinical and Experimental Pharmacology, School of Tropical Medicine, Kolkata, India.

Corresponding Author:

Dr Kunal Kanti Majumdar
163/1 NSC Bose Road, Flat no- C1, Regent Grove Apartment,
Kolkata -700040

Abstract:

Background: Various clinical features are reported in arsenicosis cases in different case and cross sectional studies. The current study examines the specificity of these features in arsenicosis cases compared to arsenic exposed and unexposed controls. **Methods:** A stratified multi-stage design was adopted for selection of participants in two districts of West Bengal. The three cohorts consisted of 108 arsenicosis cases and 100 each of arsenic exposed and unexposed controls. Socio demographic characteristics and clinical features were recorded in field study. Water samples taken by the participants and their urine and hair samples were estimated for arsenic.

Address for correspondence:
The Editor/ Managing Editor,
Journal of Comprehensive Health
Dept of Community medicine
NRS Medical College,
138, AJC Bose Road, Kolkata-700014

Results: Mean peak arsenic level in drinking water was 259.53 ± 161.49 µg/L and 259.53 ± 161.49 µg/L (p>0.05) among arsenicosis cases and arsenic exposed controls respectively while it was below detection limit in unexposed controls. There was no difference in arsenic level in urine and hair among the former group. Significantly higher number of arsenicosis cases was found among poor farmers and agricultural laborers. There was no difference in BMI and smoking habit among the three cohorts. Chronic lung Disease was present in 40.74% of arsenicosis cases compared to 8% exposed (p0.001) and 5% unexposed (p<0.001) controls. Peripheral neuritis was observed only in two arsenicosis cases. Further, significant number of these cases had weakness and hypertension compared to controls. **Conclusion:** Poor people are predominantly affected due to arsenicosis in West Bengal. Skin lesions and chronic lung disease are the major causes of morbidity in these people.
Key Words: Arsenic and health, Epidemiology of arsenicosis, Social aspect of arsenicosis, Arsenic and lung disease, Arsenicosis in West Bengal.

Introduction

Arsenic contamination in drinking water has been reported from many countries [1] in the world, but the severity of this contamination in India and Bangladesh is unprecedented. Today, in West Bengal, the arsenic contamination in ground water has been detected in 79 blocks in 8 districts of the state. It is suspected that 6 million people are exposed to arsenic contaminated ground water (>50µg/l)[1]. In India, occurrences of arsenic in groundwater have also been reported from states of Bihar, Jharkhand, Chhattisgarh, Uttar Pradesh and Assam.[1]

Over and above skin lesions, arsenicosis (chronic arsenic toxicity) has been reported to be associated with various systemic manifestations like weakness, chronic respiratory disease, peripheral neuropathy, liver fibrosis, peripheral vascular disease, pedal edema, hypertension, conjunctival congestion etc. These have been variously reported in case studies and cross sectional epidemiological studies in different countries.[2-10]

Limited information are available regarding the disease burden due to arsenicosis in West Bengal, India. All figures quoted in various publications in regard to disease burden [11-14] are based on cases identified by scattered case detection program in the arsenic affected areas of different districts of the state. In an epidemiological survey carried out in one of the affected districts of West Bengal (South 24 Parganas), where 7683 people were examined in 57 arsenic affected villages, the prevalence of arsenical skin lesion was found to be 4.6%.[15] Recently a cross sectional study, adopting stratified multistage design, described various clinical features in cases of arsenicosis and arsenic exposed controls in the district of Nadia, West Bengal, in which 1060 out of a population of 10469 were found to have arsenical skin lesion[16] However no case control study has so far been done comparing clinical features in arsenic exposed and unexposed people in the state. The current study has therefore been done to ascertain the specificity of various symptoms of arsenicosis by comparing the clinical profile in arsenicosis patients with arsenic exposed and unexposed controls in two districts of West Bengal. Further, socio demographic features of these cases have also been studied.

Materials & Methods

Study design: This study involved participants in a case (with arsenic-related skin disease) control (without skin lesion) study who were selected from two arsenic affected blocks out of 17 blocks of district Nadia, West Bengal, studied earlier[16]. One hundred participants from a village of a block (Polba) of an arsenic unaffected region of district Hoogly, age and sex matched, with arsenic exposed controls of Nadia, were taken as arsenic unexposed control (Fig. 1).

Sampling Method for initial selection of the source population: A stratified multi-stage design was adopted for selection of participants in this study. Two blocks from the 17 arsenic-affected blocks in the district of Nadia, selected on the basis of convenience in fieldwork, were taken as the two strata. These two blocks were Chakdah and Haringhata. Within each block, the villages with at least one tube-well contaminated with arsenic at a level > 50 µg/L constituted the sampling frame in respect of the first-stage units viz. villages. Data regarding arsenic contamination in tube-well water were obtained from the survey conducted by the Public Health Engineering Department (PHED) of the Govt. of West Bengal.[17] The numbers of such villages in the two selected blocks were 103 and 71 respectively, totaling to 174. Considering availability of resources, it was decided to cover 6 villages in the sample. (This would imply a sampling fraction of slightly more than 3 %) The number of villages allocated to the two blocks was made by proportional allocation principle, depending on the number of villages in each of the two blocks. Thus the number of villages selected within the two blocks came out to be four and two in Chakdah and Haringhata respectively.

The sample villages from each block were selected by pps (probability proportional to size) method. The size measure adopted was the product of the total population in a village and the proportion of arsenic-contaminated tube wells in the village. From each of the 6 selected villages, households that were the ultimate-stage units were selected by systematic sampling with a random start in the list of households. A total of 212 households were eventually covered in the sample and the total number of inhabitants in these selected households turned out to be 900. This implied that about 4% of the households in a selected village were canvassed in the present study.

Cohort selection for the present study: Cohort-1, termed as cases of arsenicosis (n=108) consisted of individuals affected with typical skin lesion of pigmentation and/or keratosis, selected randomly from 100 out of 212 households in the two blocks. Cohort-2, exposed controls (n=100) consisted of individuals without skin lesion with definite evidence of arsenic exposure > 50 µg/L, selected randomly from the 212 households examined in the two blocks. Unexposed controls (Cohort-3) were selected from a village in an arsenic unaffected region of the district of Hooghly, age and sex matched and having similar socioeconomic status as exposed controls of Nadia district.

All subjects included in this study gave written consent for their participation. Approval of the study protocol was obtained from the Ethical committee of the Foundation, fulfilling the Helsinki criteria and recommendation of Indian Council of Medical Research, Govt. of India,

Field Study: The six arsenic exposed villages selected for the study were located about 80-90 kilometers northeast of the city of Kolkata. The arsenic unaffected village selected was situated about 65 kilometer northwest of Kolkata. Each selected participant in the village was questioned briefly about his or her sources of drinking and cooking water, and duration of water

use from the source. Demographic characteristics and socio economic condition of the participant were recorded in a proforma. History taking and clinical examination of each participant was carried out by a physician having experience of detecting arsenicosis cases for many years. Diagnosis of clinical and laboratory confirmed case of arsenicosis was made on the basis of WHO Criteria.[18] . A scoring system has been adopted to classify the degrees of severity of skin manifestations according to WHO criteria with modification (Table-1)[18].

Collection of Water and biological samples and arsenic measurement: Urine and hair samples were collected from each participant and stored according to standard protocol.[18] Water samples were collected from all available current and previous private and public tube wells used for drinking and cooking purposes by each recruited house¬hold. Arsenic levels in urine and hair and in water were measured by Atomic absorption spectrophotometer with flow-injection hydride generation system.[19] The detection limit determined at the 90% confidence level was 3 µg/L.

Blood sample collection: Blood samples were collected for determination of hemoglobin level. A total of 87 samples from cohort-1, 81 samples from cohort-2 and 51 samples from cohort-3 could be collected from the participants.

Statistical analysis: Data are reported as Means + S.D. Statistical significance between groups was determined by analysis of variance with significance set at $p<0.05$.

Result

Exposure data: Among the three cohorts, significant arsenic exposure was observed through drinking water among cohort-1 (arsenic exposed cases) and cohort- 2 (arsenic exposed controls) while cohort 3 subjects (arsenic unexposed controls) were drinking arsenic safe water. There was no difference between the peak and average arsenic exposure and duration of arsenic exposure between arsenic exposed cases (with arsenical skin lesion) and exposed control (without arsenical skin lesion) subjects. The mean peak and average arsenic content in drinking water of the exposed cases were 250.56 ± 199.20 µg/L and 178.60 ± 165.38 µg/L and in exposed controls 259.53 ± 161.49 µg/L and 193.03 ± 131.52 µg/L respectively ($p>0.05$). The mean duration of peak arsenic exposure of arsenicosis cases and arsenic exposed controls was 12.87 ± 7.32 and 10.96 ± 7.69 years respectively ($p>0.05$). The arsenic level in drinking water of arsenic unexposed persons was found to be below detection level (BDL). The mean arsenic level in urine in cohort-1, 2 and 3 was 123.24 ± 99.97 µg/L, 111.71 ± 88.57 µg/L and 17.17 ± 11.39 µg/L respectively and in hair, 1.11±1.22 mg/Kg, 1.03 ± 0.64mg/Kg and 0.10 ± 0.06 mg/Kg respectively. There was no difference between mean arsenic level in biomarkers like urine ($p>0.05$) and hair ($p>0.05$) in arsenic exposed cases and arsenic exposed controls (Table-2a).

Table-1: Dermatological criteria and grading of severity according to skin score in cases of arsenicosis (WHO 2005, with modification)

Scoring System		
Pigmentation (Score)		
Mild(1)	Moderate (2)	Severe (3)

Diffuse Melanosis, Mild Spotty Pigmentation, Leucomelanosis	Moderate, Spotty pigmentation	Blotchy pigmentation Pigmentation of under surface of tongue, buccal mucosa
Mild (1)	Keratosis (Score) Moderate (2)	Severe (3)
Slight thickening, or minute papules (<2 mm) palm & soles	Multiple raised keratosis papules (2 to 5mm)in palm & soles with diffuse thickening	Diffuse, severe thickening, large discreet or confluent keratotic elevations (>5mm), palm & soles (also dorsum of extremity and trunk)

Maximum. total Skin score = 6;

Socio-demographic characteristics: The mean age of exposed cases (43.10 ± 10.64 yrs.) was higher compared to exposed control subjects (39.24 ± 10.68 yrs.) and this difference was statistically significant ($p<0.001$). However, there was no difference in mean age between exposed controls (39.24 ± 10.68 yrs.) and unexposed controls (39.96 ± 11.28 yrs.). There was no sex difference between the three cohorts (Table-2a). More poor subjects were found among exposed cases compared to exposed and unexposed controls as majority of them lived in Kutcha (mud or thatched) houses (74.07%) compared to other two groups (56% and 49% respectively, $p<0.01$). There was no difference in housing pattern between exposed and unexposed controls. Sanitary latrine was absent in 41.67% of cases and 32% of arsenic exposed controls ($p>0.05$) and 50% of arsenic unexposed controls ($p>0.05$). Farmers and agricultural laborer comprised of 40.74% of participants among arsenic exposed cases and in 22% of arsenic exposed ($p<0.01$) and 17% unexposed controls ($p<0.01$). But there was no significant difference between the later groups. Education level was poor (below primary level) in significant number of subjects in all the cohorts studied without any significant difference between each other. There was no statistical difference in smoking habit between the three groups as history of smoking was present among 27% of cases of Cohort-1, 28% of Cohort-2 and 32% of Cohort-3 subjects (Table 2a).

Table – 2a. Demographic, Socio-Economic and other features of the three cohorts studied

	Cases (Cohort-1)	Exposed Controls (Cohort-2)	Unexposed Control (Cohort-3)
	(n = 108)	(n = 100)	(n = 100)
Water :	**(Mean ± S.D.) :**	**(Mean ± S.D.) :**	
Highest known tube well arsenic concentration, (peak, ug/L)	250.56 ± 199.20	259.53 ± 161.49	
Duration of Exposure to peak arsenic concentration (years)	12.87 ± 7.32	10.96 ± 7.69	

	Cases (Cohort-1)		Exposed Controls (Cohort-2)		Unexposed Control (Cohort-3)	
	(n = 108)		(n = 100)		(n = 100)	
Average Arsenic. Exposure (ug/L)	178.60 ± 165.38		193.03 ± 131.52			
Max. Peak As Exposure (ug/L)	820		622		BDL*	
Current arsenic level in Urine : (ug/L)	123.24 ± 99.97		111.71 ± 88.57		17.17 ± 11.39	
Current arsenic level in Hair : (mg/kg)	1.11 ± 1.22		1.03 ± 0.64		0.10 ± 0.06	
Age : (yrs.)	43.10 ± 10.64		39.24 ± 10.68		39.96 ± 11.28	
	n	**%**	**n**	**%**	**n**	**%**
Sex :						
Male	66	*61.11*	60	*60.00*	60	*60.00*
Female	42	*38.89*	40	*40.00*	40	*40.00*
Type of Dwelling :						
Kutcha	80	*74.07*	56	*56.00*	49	*49.00*
Mixed and Pucca	28	*15.74*	20	*20.00*	36	*36.00*
Pucca	11	*10.19*	24	*24.00*	15	*15.00*
Occupational Status						
Housewife	37	*34.26*	34	*34.00*	37	*37.00*
Farmer and Agricultural laborer	44	*40.74*	22	*22.00*	17	*17.00*
Non Agricultural Laborer	17	*16.67*	26	*26.00*	24	*24.00*
Others	10	*9.26*	18	*18.00*	10	*10.00*
Education :						
Illiterate	27	*25.00*	16	*16.00*	34	*34.00*
Just Literate	23	*21.30*	17	*17.00*	11	*11.00*
Primary & Above	58	*53.70*	67	*67.00*	55	*55.00*
Addiction						
Smoking	31	*28.70*	27	*27.00*	32	*32.00*
Alcohol	0	*0.00*	0	*0.00*	4	*4.00*
Tobacco chewing	16	*14.81*	5	*5.00*	9	*9.00*

*BDL – Below Detection Limit

There was no difference in BMI between the three groups, significant number of participants being underweight (Table-2b).

Clinical Features: Skin lesion-Out of the 108 arsenic exposed cases arsenical pigmentation and keratosis were present in 107 and 67 cases respectively. According to total skin score arsenical skin 2) in 73 (67.6%), moderate (≤lesions were mild (>2 & 4) in 32≤ (29.6%) and severe (>4 & 6) in 3 (2.8%) arsenicosis cases≤ (Table-2b).

Systemic manifestation: Chronic lung Disease (any of the features of chronic cough for more than 3 month, chronic bronchitis or breathlessness) was present in significantly higher number (40.74%) of arsenicosis cases compared to arsenic exposed controls (8%,$p<0.05$) and unexposed control (5%, $p<0.001$) subjects. However, there was no difference in incidence of chronic lung disease between the exposed and unexposed controls ($p>0.05$). Chronic cough was present in 21.3% of cohort-1, 4% of cohort 2 ($p<0.001$) and 1% of cohort 3 ($p<0.001$) subjects while the incidence of chronic bronchitis was 12% in cohort-1, 4% in

cohort-2 ($p<0.05$) and 4% in cohort-3 ($p<0.05$) subjects respectively. Chronic breathing difficulty was present in 9.26% of cases among the cohort-1 while in none among the other two cohorts (Table-2b).
Peripheral neuritis and defective hearing were observed in 2 cases each while dim vision was found in 7 cases of arsenicosis but in none of the arsenic exposed and unexposed subjects. Dyspepsia, Chronic diarrhea, hepatosplenomagaly and musculo-sceletol symptoms were found in some of the arseicosis cases, however there was no statistical difference in occurrence of similar symptoms in arsenic exposed and unexposed subjects (Table-2b).

Table – 2b : Data on BMI, arsenical skin score and clinical characteristics of the three cohorts studied in Nadia.

	Cases (Cohort-1)		Exposed Controls (Cohort-2)		Unexposed Control (Cohort-3)	
	(n = 108)		(n = 100)		(n = 100)	
BMI Classification	**n**	**%**	**n**	**%**	**n**	**%**
Under Weight (<18.50)	38	*35.19*	27	*27.00*	24	*24.00*
Normal (18.50 - 24.99)	61	*56.48*	61	*61.00*	61	*61.00*
Pre-Obese (25.00-29.99)	7	*6.48*	11	*11.00*	14	*14.00*
Obese	2	*1.85*	1	*1.00*	1	*1.00*
Arsenicosis Skin Score						
Mild (>0 & ≤2)	73	67.59				
Moderate (>2 & ≤4)	32	29.63				
Severe (>4 & ≤6)	3	2.78				
Hypertension						
Systolic Hypertension (B.P≥140mmHg)	30	27.78	16	16.00	19	*19.00*
Diastolic Hypertension(B.P≥90mmHg)	26	*24.07*	18	*18.00*	12	*12.00*
Symptoms						
	n	**%**	**n**	**%**	**n**	**%**
Weakness	34	*31.48*	13	*13.00*	12	*12.00*
Lung Disease	44	*40.74*	8	*8.00*	5	*5.00*
Chronic cough	23	*21.30*	4	*4.00*	1	*1.00*
Chronic brochitis	12	*11.11*	4	*4.00*	4	*4.00*
Breathlessness (COPD)	10	*9.26*	0	*0.00*	0	*0.00*
Dyspepsia	18	*16.67*	25	*25.00*	12	*12.00*
Ch. Diarrhoea	2	*1.85*	0	*0.00*	1	*1.00*
Hepatomegaly	4	*3.70*	6	*6.00*	1	*1.00*
Musculo-skeletal Pain	13	*12.04*	25	*25.00*	20	*20.00*
Peripheral Neuritis	2	*1.85*	0	*0.00*	0	*0.00*
Hearing Defect	2	*1.85*	0	*0.00*	0	*0.00*

	Cases (Cohort-1)		Exposed Controls (Cohort-2)		Unexposed Control (Cohort-3)	
	(n = 108)		(n = 100)		(n = 100)	
Dim Vision	7	*6.48*	0	*0.00*	0	*0.00*
Anaemia Classification						
Male (n)	**53**		**50**		**33**	
Total Anaemia (≤12 gm%)	17	32.08	12	22.45	8	*24.24*
Female (n)	**34**		**31**		**18**	
Total Anaemia (≤11 gm%)	20	*58.82*	18	*58.06*	10	*55.56*

There was increased occurrence of weakness among arsenicosis cases (37%) compared to arsenic exposed (13%, p<0.001) and unexposed controls (12%, p <0.001). However there was no difference in occurrence of weakness among the later two groups (p>0.5) (Table-2b). Diastolic hypertension (BP > 90 mmHg was observed in significantly higher number of arsenicosis cases compared to arsenic unexposed controls (24% vs 12%, p<0.05). Further, systolic hypertension (BP >140 mmHg) was found in significantly higher number of arsenicosis cases compared to arsenic exposed controls (27.78 % vs 16%, p<0.05). However, there was no difference in systolic (p>0.05) and diastolic blood pressure (p>0.05) between the arsenic exposed and arsenic unexposed controls.

On the basis of hemoglobin estimation significant number of cases of anaemia was found in females (55-58%) and males (22-32%) in all the three cohorts, but there was no significant difference in its occurrence among them.

Table – 3 : Arsenic Exposure Data and Clinical Features of Arsenic Exposed Population in Cross-Sectional Study of Nadia District, West Bengal

Parameter	*2006-07 Population based Study in Nadia in Arsenic Endemic Region (N = 10469)				p-value
	As Exposed with Skin Lesion (Cases)		As Exposed without Skin Lesions (Control)		
(Mean ± S.D.) :	**(n = 1616)**		**(n = 8853)**		
Water : Peak As. Exposure (µg/L)	103.469 ± 153.289		73.187 ± 115.105		<0.001
Water : Max. Range of As Exposure (µg/L)	890		1362		
Age	53.36 ± 15.60		33.74. ± 15.99		<0.001
Sex :	**N**	**%**	**N**	**%**	
Male	934	*57.80*	3213	*36.29*	<0.001
Female	682	*42.20*	5640	*63.71*	<0.001
Disease Symptoms :					
Chronic Cough	127	*7.86*	52	*0.59*	<0.001
Breathlessness (COPD)	146	*9.03*	39	*0.44*	<0.001
Dyspepsia	67	*4.15*	77	*0.87*	<0.001
. Ch. Diarrhoea	19	*1.18*	15	*0.17*	<0.001

Liver-Palpable	5	*0.31*	0	*0.00*	<0.001
Ascities	3	*0.19*	1	*0.01*	<0.05
Pallor (Anaemia)	1	*0.06*	7	*0.08*	>0.05
Non pitting oedema of limbs	4	*0.25*	2	*0.02*	<0.01
Peripheral Neuritis	257	*15.90*	136	*1.54*	<0.001

*Guha Mazumder et al., 2010.

Discussion:

This is the first case control study assessing socio economic characteristics and clinical profile of chronic arsenic exposed subjects in one of the arsenic affected district comparing with a similar cohort selected from an arsenic unexposed district of West Bengal. Both the arsenicosis cases and arsenic exposed controls were significantly exposed to arsenic, having similar mean peak, duration and average level of arsenic intake through drinking water with no difference in arsenic excretion in their urine and hair. In this study, poor people were found to be significantly affected with arsenical skin lesion. Similar is the finding in Bangladesh where people belonging to lower socioeconomic class are found to be associated with increased risk of arsenical skin lesion.[20-21] Farmers and agricultural laborers were found to be associated with significantly increased risk of developing arsenical skin lesion compared to arsenic exposed controls. This may be due to their additional risk of increased arsenic exposure from drinking water from arsenic contaminated tube wells (used for irrigation purposes) in the rice fields during their long working hours there.

In this study more males with higher age were found to have arsenical skin lesion compared to arsenic exposed controls. Similar was the finding in cross sectional studies carried out in whole district of Nadia (Table-3).[16] Arsenical skin lesions were found to be mild in 68% of cases in this cohort of 108 arsenicosis cases (Table-2b). It is important to know the severity of arsenical skin lesion in a population as milder form of disease improves with intake of arsenic uncontaminated water and high protein diet. [10, 22]

Significant morbidity of the arsenicosis cases were found due to chronic lung disease in arsenicosis cases compared to arsenic exposed and unexposed controls. There was no difference in smoking habit between the three cohorts. Chronic cough was found in 21% of cases of arsenicosis in the present study while the incidence was low (7.8%) in cross sectional study carried out in whole of the district of Nadia.[16] However breathlessness (COPD) was found in 9% of cases of arsenicosis in both the studies(Table-2b & 3). Symptoms of chronic respiratory disease associated with prolonged drinking of arsenic contaminated water have been reported by many workers in West Bengal, Bangladesh and China.[4,6-8,23-25] Further abnormal lung function tests characterized by obstructive and restrictive lung disease and Bronchiectesis diagnosed by high resolution CT were reported in hospital based and case control studies in West Bengal.[4, 25-27]

Peripheral neuritis and defective hearing were observed in 2 cases each while dim vision was found in 7 cases of arsenicosis but in none of the arsenic exposed and unexposed control subjects. As specialized examination of eye and ear was not possible in the field survey, no definite comment could be made whether defective hearing and dim-vision found in our cases were caused by neurological deficit. Though peripheral neuritis was found in small number of arsenicosis cases in our current study, higher incidence was observed in

larger cross sectional study of Nadia (Table 3). Peripheral neuritis associated with chronic arsenic toxicity has been reported by many other workers.[7-8,28-32]

Hypertension was found in significantly higher number of arsenicosis cases compared to arsenic exposed and unexposed controls. Hypertension has also been reported in Taiwan and Bangladesh in significant number of arsenic exposed population.[33,34] More arsenicosis cases had weakness compared to the two control subjects. Weakness has also been reported in cases of arsenicosis in earlier studies.[4,28,31]

In the present study there was no difference in occurrence of hepatomegaly, dyspepsia, chronic diarrhea, and musculo-skeletal symptoms in arsenicosis cases compared to arsenic exposed controls. However, liver enlargement was reported following drinking of arsenic contaminated water by several workers.[6-8,28] Further, thirteen arsenic exposed (200-2000 μg/L) people having hepatomegaly, when investigated in a hospital in West Bengal, showed evidences of portal zone expansion and fibrosis on liver histology (Noncirrhotic portal fibrosis-NCPF). The arsenic level in liver tissue was found to be elevated in 10 out of those 13 cases (As levels: Cases- 0.5 to 6 mg/kg; control- 0.10 ± 0.04 mg/kg). [2]

Dyspepsia, chronic diarrhea, hepatomegaly and ascites were also found in significanly higher number of arsenicosis cases compared to arsenic exposed controls in earlier cross sectional study in whole of the district of Nadia (Table-3). Peripheral vascular disease, though frequently reported in cases of arsenicosis in Taiwan, a small number of such cases have been reported from West Bengal.[4,35,36] Non-pitting edema of the legs and hands have also been reported in patients of chronic arsenic toxicity in West Bengal and Bangladesh.[4,8,37,38] However, none of our cases in this case-control study showed these features On the basis of hemoglobin estimation, significant number of cases (both males and females) had anaemia among the three cohorts studied, but there was no significant difference of its occurrence among them. In earlier hospital based studies anaemia was reported by us in cases of asenicosis.[2,4] However no association of anaemia was found in people drinking well water (mean 0.22mg/L) in Alaska and in two towns of Utah (arsenic exposure 0.18 mg/L and 0.27 mg/L[39].

Limitation of this study is inclusion of smaller number of subjects in this case control study. That may be the reason for finding of insignificant difference in occurrence of clinical features like anaemia, dyspepsia, hepatomegaly, ascites and pedal edema in arsenic exposed cases compared to exposed controls in this case control study. However, the strength of the study is the inclusion of arsenic unexposed controls for assessment of baseline disease pattern in the population with similar socio econonomic characteristics as arsenic exposed population to ascertain the predominant systemic features in cases of arsenicosis.

Conclusion:

From the present study it appears that environmental arsenic toxicity associated with arsenical skin lesion causes significant morbidity in poor people in West Bengal due to chronic lung disease, neuropathy, weakness and hypertension. Other features like liver involvement, gastrointestinal symptoms, peripheral vascular disease and pedal edema etc. though reported in various case studies and cross-sectional studies in arsenic exposed population, these are not of frequent occurrence.

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Conflicts of Interest of each author/ contributor -

Nil

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