

# Ground Water Arsenic Contamination in Malda, West Bengal, India: Epidemiology and Efficacy of Mitigation Measures

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## ABSTRACT

**Background and Objectives:** Health hazard due to arsenic exposure through ground water is a major problem in West Bengal. The State Government is involved in supplying arsenic safe water to the population. An epidemiological study is done on Malda, one of the severely arsenic affected district of West Bengal. Quality of drinking water and its availability to the people have also been assessed. **Methods:** A population based cross sectional study was done in Malda. Water from household tube well was tested for arsenic and availability of safe water was assessed. **Results:** Four hundred and forty-six (8.3%) cases of arsenicosis with typical skin lesion were detected out of 5355 participants examined in 2013 households studied in seven affected blocks of Malda. Out of 1638 water samples tested from home tube wells, 78% of water samples were found to be contaminated with arsenic >0.01 mg/L. Out of 81 habitations surveyed, 68 habitations had pipelines constructed for supplying arsenic safe water. However, supply was regular in four habitations only. Arsenic safe water (<0.01mg/L) was available from 5 tube wells out of 21 tube wells constructed by PHED in the habitations. **Interpretation and Conclusion:** Significant number of arsenicosis cases were identified in Malda district. Large number of home tube wells were contaminated with arsenic. In spite of presence of PHED tube wells and pipelines in most arsenic affected habitations, safe water was not available to most people.

**Key words:** Arsenic epidemiology, Arsenicosis, Water quality, Safe water availability, Arsenic in West Bengal.

## INTRODUCTION

Chronic arsenic toxicity (arsenicosis) due to drinking of arsenic contaminated ground water is a major environmental health hazard throughout the world including India and Bangladesh. In India, occurrence of arsenic in groundwater has been reported from West Bengal, Bihar, Jharkhand, Chhattisgarh, Uttar Pradesh and Assam.<sup>1</sup>

Though many states have been identified with significant arsenic contamination in groundwater in India, the major affection was detected as early as 1983 in West Bengal.<sup>2</sup> Significant affection has been observed in the districts of Malda, Murshidabad, Nadia, Burdwan and North and South 24 Parganas. In the past several epidemiological studies have been carried out in many arsenic affected districts, of West Bengal,<sup>3-8</sup> but no such study has so far been done in Malda district. Current report is based on an epidemiological study carried out for determining the prevalence of arsenicosis patients in the arsenic affected regions of the 7 arsenic affected blocks of district of Malda.

As a part of 'Arsenic Mitigation Program', Public Health Engineering Department (PHED), Govt. of West Bengal has been involved, in arranging to supply arsenic safe water to the affected population since detection of the problem. Arsenic Master Plan was

prepared by PHED suggesting measures to supply safe drinking water to the arsenic affected people through construction of tube wells and pipe lines.<sup>9</sup> About 211 nos. of schemes out of 338 nos. of piped water supply schemes drawn under the Master Plan had been commissioned, whereas the rest 27 nos. of schemes were scheduled to be commissioned by December, 2017.<sup>10</sup> However no study has so far been done to evaluate the efficacy of supplying safe drinking water through constructing tube wells and pipe supply schemes in ensuring availability of safe water to the arsenic affected people. Current study is intended to assess the efficacy of supplying arsenic safe water to the arsenic affected people in the district of Malda. This study also involved determination of quality of drinking water used by the affected families and assessment of availability of arsenic safe water supplied through pipe line and tube wells constructed by PHED in the affected region. Further people's perception about the quality of drinking water available to them were also studied.

Approval of the study protocol was obtained from the Ethical Committee of the DNGM Research Foundation, fulfilling the recommendation of the Indian Council of Medical Research, Government of India.

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Informed consent was taken from each participant before carrying out an interview.

## MATERIALS AND METHODS

A cross sectional epidemiological study was carried out in 7 arsenic affected blocks of Malda, West Bengal. These 7 blocks were selected purposely as these are the arsenic affected blocks of Malda District of West Bengal according to report of PHED, Govt. of West Bengal.<sup>11</sup> Twenty six Gram Panchayets (GPs) were selected within the 7 arsenic affected blocks based on presence of arsenic contamination of public tube wells in the district of Malda. (Vide. Habitation arsenic data for West Bengal PHED.<sup>12</sup> Forty two villages were selected purposefully within these 26 GPs where 50% of public tube wells were contaminated >0.3mg/L of arsenic. Eighty one habitations were selected randomly from these 42 villages and a total of 2013 households were selected by random sampling from these habitations. All members of the household were examined by expert doctor for detection of skin lesions characteristic of arsenicosis. Severity of skin lesions were determined according to the scoring system described earlier.<sup>7</sup>

Water Samples were collected from each home tube well during the house to house survey for testing for arsenic content at the Reference Laboratory of PHED for Water Testing by Atomic Absorption Spectrophotometer at Malda. Documentation on source and quality of drinking water used by the families and information about the availability of arsenic free safe drinking water source to the studied families were also done. Whether piped water supply was absent, supplied regularly or irregularly in the habitations was noted and quality of supplied water was also recorded. Whether there was any misusage and pilferage of public water supply was also noted. People's perception about the quality of drinking water available to them were also studied.

Number of tube wells constructed by PHED in the habitations surveyed for supply of arsenic safe water was also recorded and water samples collected for testing for arsenic. Other source of drinking water like Dug well or River water used by people in absence of PHED supplied source were also recorded and water collected for testing for arsenic.

## RESULTS

In all 446 (8.3%) cases of arsenicosis (subjects with skin lesion) were detected out of 5355 participants examined during house to house visit. There was no significant difference in education and occupation between participants with (cases) and without skin lesion (non – cases). However higher (65%) percent of cases belonged to BPL category compared to non-cases (56.4%). Thirty seven percent of cases and 44.7% of non-cases lived in Pucca houses. Significantly more (295, 66.1%) males were having skin lesion compared to females (151, 33.9%;  $p < 0.05$ ). Arsenical pigmentation was found to be present in 440 subjects. Pigmentation was mild in 294 (66.8%) cases, moderate in 120 (27.27%) cases while severe in 26 (5.9%) cases. Arsenical keratosis was present in 209 subjects. Keratosis was mild in 148 (70.81%) moderate in 52 (24.88%) cases and severe in 9 (4.3%) cases. Clinical symptoms are presented in Table 1.

Health staffs of the state district health officials were not aware of the presence of so many arsenicosis patients in the district of Malda.

Out of 1665 water samples collected, 1638 samples were taken from home tube wells of the participants, 21 from public tube wells, 2 samples from dug wells and 4 samples from nearby river from where people were collecting water for drinking purpose. Out of water samples collected from home tube wells, 1278 (78%) samples were found to have arsenic contamination >0.01 mg/L (Table 2). Maximum concentration of arsenic in drinking water of home tube well was found to be 0.99 mg /L. Arsenic content of water taken from dug wells and river were found to be

**Table 1: Characteristics of 5355 participants studied in regard to their clinical features and Arsenic exposure through drinking water.**

Characteristics	Cases (With pigmentn. And keratosis)		Controls (Without pigmentn. And keratosis)		P value
	N=446		N=4909		
As concentration in drinking water (mg/L)					
Minimum	BDL		BDL		
Maximum	0.92		0.99		
Mean	0.38		0.19		<0.05
Median	0.40		0.10		<0.05
SD	0.245		0.213		
Age	N	%	N	%	
<12	0	0.00	40	0.81	
12-<18	5	1.12	495	10.08	
18-<30	49	10.99	1464	29.82	
30-<60	275	61.66	2356	47.99	
>60	117	26.23	554	11.29	
Sex	N	%	N	%	
Male	295	66.1	1951	39.74	<0.05
Female	151	33.9	2958	60.26	<0.05
Clinical Features	N		% N		
Pigmentation					
Mild	294	66.8	0		
Moderate	120	27.27	0		
Severe	26	5.9	0		
Keratosis					
Mild	148	70.8	0		
Moderate	52	24.88	0		
Severe	9	4.3	0		
Cough	70	15.7	0		
Dyspnoea	52	11.7	0		
Solid Endema Limb	1	0.2	0		
Weakness	121	27.1	0		
Diarrhea	15	3.4	0		
Limb Pain	62	13.9	0		
Tinging	72	16.1	0		
Liver Enlargement	1	0.2	0		
Pitting Limb Swelling	2	0.4	0		
Gangrene	1	0.2	0		
Conjestion of Eye/ Location	2	0.4	0		
Skin Cancer	8	1.79	0		
Bowens Disease	60	13.5	0		

**Table 2: Range of arsenic contamination in tube well water collected from households.**

Range of As contamination mg/L	No. of Home tube wells	Percentage
≤0.01	360	21.97
>0.01≤0.05	229	13.98
>0.05≤0.3	526	32.11
>0.3≤0.6	380	23.19
>0.6	143	8.73
Total	1638	100%

<0.01mg/L. Out of 81 habitations surveyed, 68 habitations had pipelines constructed by PHED for supply of arsenic free safe water. However, regular water supply was available only in 4 habitations, while supply was irregular in 38 and there was no supply in 26 habitations. In absence of non-availability of safe water from pipelines people were drinking water from PHED Tube wells. However, water samples collected, from 16 (76%) out of 21 PHED tube wells found, were contaminated with arsenic >0.01/L, (Maximum being 0.48mg/L). People were drinking water from dug wells (As <0.01mg/L) in four and from rive source (As <0.01mg/L) in four habitation shaving no safe source. Many people were drinking water from their home tube wells without knowing their arsenic contamination status irrespective of presence or absence of pipe water supply or PHED tube well.

Lot of dissatisfaction of people was found about availability of arsenic safe water supplied by PHED pipeline. The reasons for dissatisfaction are: a) non availability and irregularity of piped water supply, b) unpleasant odor, color (muddy color) of supplied water. There was lot of wastage of pipe water supply noted. Pilferage by tapping of pipeline for irrigation purpose, using water for taking bath and washing and loss by damage of pipelines were noted during supply of water through pipelines constructed by PHED.

## DISCUSSION

Prevalence of arsenicosis was found to be 8.3% in Malda district, comparatively lower than that found in nearby districts of Murshidabad (19%)<sup>6</sup> and Nadia (15.43%)<sup>7</sup> in West Bengal.

Though as many as 446 cases of arsenicosis were identified in the Malda district however no information was available with the medical officers of Block Health Centers, district and state health officials on the presence of arsenicosis cases in the district. It is alarming to note that as many as 1278 (78%) water samples were found to have arsenic contamination >0.01 mg/L out of 1638 water samples tested from home tube wells of the participants surveyed. It is a matter of great concern that many of the people living in arsenic affected area are still drinking arsenic contaminated water from their home tube wells inspite of Govt.'s effort of supplying safe water. It is imperative that state policy should be taken to test all private tube wells and take control of the installation and monitoring of private tube wells so that they do not continue to drink arsenic contaminated water from their home tube wells. People need to be made aware not to drink arsenic contaminated water for prevention of arsenic related health hazard.

It is also a matter of concern that there was a lack of satisfaction of people in villages about the supply of arsenic free water by PHED. The reasons for dissatisfaction are non-availability and irregularity of piped water supply in spite of construction of pipeline in as many as 63 out of 81 habitations studied. It is also deplorable that there was lot of wastage of pipe water supply by pilferage of water from pipeline constructed by PHED.

It appears that there is a gap between water supply system constructed by PHED and community benefit of getting safe water. There is lack of supervision from the state administration for continued follow up for ensuring regular water supply through constructed pipelines and taking corrective measures for preventing pilferage by the state administration. Further regular checking of quality of tube well water need to be done so that the water available through these are not still contaminated with arsenic again. It appears that the community is not taking the ownership in maintaining the water supply system for their own benefit. There appears to be a communication gap. A communication platform needs to be created for interaction with PHED on the one hand and community on the other so that community ownership develops.

## CONCLUSION

Significant numbers of arsenicosis cases were identified in Malda district. Large number of home tube wells was contaminated with arsenic. In spite of presence of PHED tube wells and pipelines in most arsenic affected habitations, safe water was not available to most people. It appears that there is a gap between water supply system constructed by PHED and community benefit of getting safe water. A communication platform needs to be created for interaction with PHED on the one hand and community on the other so that community ownership develops in maintaining the water supply system.

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## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## ABBREVIATIONS

**PHED:** Public Health Engineering Department; **GPs:** Gram Panchayets; **As:** Arsenic.

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