Prevalence, knowledge, attitude and practice about arsenicosis and arsenic contamination in water sources in Shyampur II block, district Haora, West Bengal, India, 2005

BY

Gaurab Roy

MAE – FETP Scholar, 2004-2005

DISSERTATION PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF APPLIED EPIDEMIOLOGY (M.A.E.)

OF

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES AND TECHNOLOGY, THIRUVANANTHAPURAM – 695011, INDIA

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National Institute of Epidemiology,

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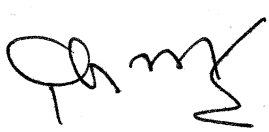
CERTIFICATION

This is to certify that this dissertation, entitled 'Prevalence, knowledge, attitude and practice about arsenicosis and arsenic contamination in water sources in Shyampur II block, district Haora, West Bengal, India, 2005', submitted by Dr. Gaurab Roy, in partial fulfillment of the requirements for the degree of Master of Applied Epidemiology, is the original work done by him and has not been submitted earlier, in part or whole, for any other (Publication or degree) purpose.



Director

National Institute of Epidemiology

Dated:

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Dated: (GAURAB ROY)

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ABBREVIATION

WB:	West Bengal
GOWB:	Government of West Bengal
UNICEF:	United Nations International Children's Emergency Fund
WHO:	World Health Organization
SEARO:	South East Asia Regional Office
JPOA:	Joint Plan of Action
DMSA:	Dimercaptosuccinic acid
DMPS:	Dimercaptopropane sulphate
DNA:	Deoxyribo Nucleic Acid
DHS:	Director of Health Services
Jt. DHS:	Joint Director of Health Services
CMOH:	Chief Medical Officer of Health
DyCMOH:	Deputy Chief Medical Officer of Health
ACMOH:	Assistant Chief Medical Officer of Health
BMOH:	Block Medical Officer of Health
BSI:	Block Sanitary Inspector
BPHN:	Block Public Health Nurse
HS:	Health Supervisor
MPHW:	Multi-Purpose Health Worker
DH:	District Hospital
SDH:	Sub-Divisional Hospital
SGH:	State General Hospital
RH:	Rural Hospital
BPHC:	Block Primary Health Centre
IPGMER:	Institute of Post-Graduate Medical Education and Research
STM:	School of Tropical Medicine
AIIH&PH:	All India Institute of Hygiene and Public Health
NICED:	National Institute of Cholera and Enteric Diseases
NIE:	National Institute of Epidemiology
ICMR:	Indian Council of Medical Research
PHED:	Public Heath Engineering Department
NGO:	Non Government Organization
UNICEF:	United Nation's International Children's Educational Fund

ABSTRACT

Background: Globally, 24 countries have reported arsenic contamination in groundwater and its impact on human. In nine districts of state West Bengal, India, 42.7 million people are exposed to ground water arsenic contamination. Government of West Bengal and UNICEF formed a strategic alliance for arsenic mitigation in 1999. They identified 75 arsenic contaminated blocks and introduced arsenic mitigation programme. Shyampur II, under district Haora, is among the contaminated blocks. In the absence of community based data on arsenicosis, we conducted a survey with objectives to (1) estimate the prevalence of arsenicosis (2) identify water sources used by the selected households with arsenic content above permissible limit and (3) estimate the current level of knowledge, attitude and practice about arsenicosis, arsenic contamination, prevention and early health seeking.

Methods: We used case-definition adapted by the WHO. We calculated a sample size of 785 based on hypothesized prevalence of arsenicosis as 18%. We selected 160 households from 16 villages in the block. We used a pre-designed pre-tested data collection instrument. Only permanent residents were considered and for children parents were interviewed. We collected water samples for arsenic contents. We calculated point estimates and 95% Confidence Interval (95% CI)

Result: We did not identify any florid arsenicosis patient. However, prevalence of hyperkeratosis was 2.6 per 1000 population (95% CI: 0.05-0.99). Of 426 water samples 371 (87%) had arsenic below detection level. Of 704 responded, 266 (38%; 95% CI: 34 – 41) participants knew about arsenicosis, 154 (22%; 95% CI: 19 – 25) knew the symptoms, 247 knew the cause of arsenicosis, 529 (75%; 95% CI: 72-78) would seek medical care, 464 (66%; 95% CI: 62 – 69) would seek alternative safe source of water if their source would be contaminated, 481 (68%; 95% CI: 65 – 72) agreed to share their sources if others' sources would be contaminated, 449 (64%; 95% CI: 60– 67) told that they were using safe water, 426 (61%; 95% CI 57 – 64) knew about the arsenic clinic and 637 (90%; 95% CI: 88 – 92) would attend the clinic if required.

Conclusion and recommendation:

The survey did not identify any florid case of arsenicosis and water samples from the tube wells showed arsenic level were well below the permissible level. Further studies are required to exclude the arsenic contamination status of Shyampur II block.

Key words:

Arsenicosis, contamination, mitigation,

1. INTRODUCTION

Globally arsenic toxicity is reported from 24 countries due to arsenic contamination [1,2,3,4,5,7]. Contamination is caused by arsenic from the natural geological sources leaching into aquifers, contaminating drinking water and may also occur from mining, smelting, refining of ores and other industrial processes. Arsenic poisoning could lead to both acute and chronic manifestations [8,9,13,14]. Acute arsenic poisoning is associated initially with nausea, vomiting, abdominal pain and diarrhoea. Encephalopathy and peripheral neuropathy are reported. Chronic arsenic toxicity results in multi-system disease, manifesting mainly as skin lesions. The focus of management is to reduce arsenic ingestion from drinking water and there is increasing emphasis on using alternative supplies of water [15,46,47,48,51,57]

Bangladesh and West Bengal state of India are mostly affected [8,9,13]. In 42 districts in Southern Bangladesh 79.9 million population and in nine adjacent districts in West Bengal, India 42.7 million people are exposed to ground water arsenic contamination [14]. This environmental contamination began in West Bengal, in the late 1960s, when digging of tube wells commenced as a part of a state wise irrigation and public health plan [13,14,15,16,17]. The contamination of ground water with arsenic was first detected in 1978 and the first arsenic cases were reported at School of Tropical Medicine, Kolkata, in 1982. Most of the affected villages are located along the western side of the river Ganga [8,9,15,16,17].

In 1999, Government of West Bengal and UNICEF formed a strategic alliance, called 'Joint Plan of Action (JPOA)' for arsenic mitigation. The basic goal of mitigation programme is through a strategy of identification, education and mitigation. Shaympur II block of distrct Haora is one of the 75 blocks identified as arsenic contaminated[8,9,10]. In 2004, we evaluated the arsenic mitigation programme and observed that 5% of the study population had arsenical skin lesions. However, this data was not sufficient to estimate the prevalence of chronic arsenicosis in the community [10,11,12].

Hence, we conducted the survey with objectives to: (1) estimate the prevalence of chronic arsenicosis in Shyampur II block, Haora (2) identify water sources used by the selected households with arsenic content above permissible limit (3) estimate the current level of knowledge, attitude and practice about arsenicosis, arsenic contamination, prevention and early health seeking behaviour and (4) suggest recommendations for improving arsenic mitigation programme.

2. RATIONALE OF THE STUDY

Shyampur II Block of district Haora is located along the western bank of the river Ganga. It was identified as arsenic contaminated by arsenic mitigation programme.[8,9,10,11]

In November 2004, the chief medical officer of district Haora nominated me as the district level monitoring officer of health programmes including arsenic mitigation programme in Shyampur I and Shyampur II blocks. As programme officer, we wanted to know the magnitude of arsenic problem in Shyampur II block. However, we could not find any community based data on arsenicosis from block, subdivision, district and state levels. [10,11,12.] Subsequently, we evaluated the arsenic mitigation programme in Shyampur II block from January to May 2005 and identified that only 5% of the population survedy had chronic arsenical skin lesions. This was in contrast to studies conducted in different arsenic contaminated parts of West Bengal indicating prevalence in the range of 18% to 25% [16,23,47]. However, these studies had used different case definitions, hence it was difficult to compare the estimates derived from these studies. Therefore, we proposed to generate community based data using a standard case definition adapted by the World Health Organisation – South East Asia Regional Office (WHO-SEARO)[5].

Our research question was: "What is the prevalence of arsenicosis in Shyampur II block and what the extent of arsenical contamination in water sources is?" Further, we were interested to determine the knowledge, attitude and practice about arsenic contaminated water sources, symptoms of arsenicosis, cause of arsenicosis, sequelae and prevention, early health seeking behaviour and accessibility of arsenic clinic in the neighbourhood. We believed such data would support arsenic mitigation programme in Shyampur II block.

3. REVIEW OF LITERATURE

We reviewed different literature using manual and computerized methods to identify a set of potentially useful articles and books from National Institute of Epidemiology, Chennai, All India Institute of Hygiene & Public Health, Kolkata and Institute of Post Graduate Medical, Education and Research libraries. We collected records from offices of department of health and related departments, UNICEF and Ananda Niketan. We searched to identify mainly those studies, which deal with chronic arsenicosis problem of West Bengal. We developed questions of the research and for further research. We searched PubMed (www.pubmed.gov), MEDLINE[59,60] important sources. After reviewing all relevant literature available and studied, we constructed the outline of the review of literature. We considered risk factors, ethical issues, mode of contamination, environmental issues, mitigation options etc.

3.1 HISTORICAL REVIEW

Arsenic was known from ancient times. It was commonly used in medicines, colour, dyes, pesticides, insecticides etc. It was also used as poison ('Seko Bish') [23,65]. Some researcher suspected that Napolean was poisoned to death by arsenic when he was banished at St. Helena Island [64]. But geological contamination of a large part of the globe and consequent chronic poisoning to a large population is new to the world community [14].

3.2 ARSENIC IN ENVIRONMENT

Arsenic, a metalloid, symboled as As with atomic number 33, atomic weight 74.9216 belongs to group VA in the periodic table. The average concentration of arsenic in the earth's crust is about 2mg/kg. The air in non-urban and non industrial area contains very low level of arsenic, generally $< 0.01\ \mu g/m^3$. If combines with hydrogen, arsenic, forms a very toxic arsine gas. [28,35]

Arsenic is ubiquitous in the biosphere. Most of the foods contain minute amount of arsenic, averaging 0.02 ppm. Arsenic is also a normal constituent of human body. Both organic and inorganic form of arsenic can be detected in natural water system. A number of microorganisms have the capacity to methylate inorganic arsenic (biomethylation) to the much less toxic compounds like monomethyle arsonic acid (MMAA) and dimethyle arsonic acid (DMAA), the later is readily converted in soil to the volatile methyle arsines. Algae, transform naturally occurring arsenates in water into varieties of organic compounds. In West Bengal arsenite and

arsenate are present in the ground water in 1:1 ratio. Fish and crustaceans accumulate arsenic compounds via food chain. [24,40]

Inorganic arsenical compounds are widely found in soils and ores, usually combined with iron and sulphur in the form of pyrites and sulphides [2125,34]. Arsenic is found in food preservatives, medicines (e.g., Arsenic trioxide is used in promyelocytic leukaemia), paints, dyes, fertilizers, pesticides etc. Absorption occurs predominantly from the small intestines and arsenic exerts its toxicity by inhibiting 200 enzymes particularly those involved in cellular energy pathways and DNA synthesis and repair [7,14].

3.3 MECHANISM OF CONTAMINATION

The mechanism of arsenic accumulation in Bengal Delta Plain is thought to have occurred during the late quarternary age (Holocene age) with arsenic containing alluvial sediment deposited by the Ganga, Brahmaputra, Meghna and other rivers that flow across into the Bay of Bengal. Here the arsenic is absorbed as arsenic oxyanions into oxyhydroxites of iron, aluminium and manganese and then mobilized in the alluvial aquifers where, due to the reducing environment, the hydroxides are dissolved by biochemical process, releasing the arsenic into the ground water [14,15].

3.4 ARSENIC IN THE BODY

Following exposure to arsenic, it enters the blood and subsequently is found mainly in liver and muscles, kidneys, spleen and skin. Smaller quantities are also found in the brain, heart, uterus, thyroid and pancreas, as well as hair and nails. [36,37,38.] Arsenic is eliminated from the body by the rapid urinary excretion. When inorganic arsenicals are ingested, urine forms the main route of elimination and the metabolites of inorganic arsenicals are predominant species in the urine[41]. The level at which overloading of detoxification system occurs may be lowered by a protein deficient diet. [35,36,37,38]

When small amount of arsenic (>0.5mg/day) for a prolonged period of time or a large quantity is taken within a very short span of time, detoxification mechanism fails to eliminate the overload and arsenic starts exerting its toxic effect in the body. Arsenic is believed to exert most of its effects by inhibiting sulfhydryl (-SH) enzyme system essential to cellular metabolism. Thus the net effect is the blocking of fat and carbohydrate metabolism and cellular respiration. [25,39,40]

The toxicity of arsenic compounds depends on the chemical and physical form of the compound, the route by which it enters the body, the dose and duration of exposure, dietary levels of interacting elements, and the age and sex of the exposed individuals. Arsine is considered to be the most toxic form followed by arsenites (AsIII), arsenates (AsV) and organic arsenic compounds (MMA, DMAA) [28,43].

3.5 ACUTE ARSENIC POISONING

Acute symptoms develop within 30 minutes to 2 hours in the form of sudden and explosive gastro enteritis. Common symptoms include: nausea, vomiting, paralysis of the throat muscles, abdominal pain, rice-watery diarrhoea turning into dysentery, progressive generalized weakness and severe dehydration leading to collapse and heart failure. The sequelae of acute poisoning include loss of hair and brittle finger nails with white horizontal striae (Mee's lines). Peripheral nervous disturbances, primarily of sensory type, are frequently encountered in individuals surviving poisoning. [40]

3.6 CHRONIC ARSENICOSIS

Chronic arsenic poisoning or arsenicosis occurs from chronic exposure from arsenic contaminated water or other sources, like medicines containing arsenic or arsenic contaminated food etc. Chronic arsenicosis is a multi-system disorder related to skin, gastrointestinal tract, nervous system, mucus membranes, lungs, liver and other systems. Symptoms and signs of chronic arsenicosis are:

(i) General: anaemia, jaundice, malnutrition, non-pitting oedema, clubbing, progressive generalized weakness, oversweating.

(ii) Eye: conjunctival congestion.

(iii) Ear-nose-throat: epistaxis.

(iv) Teeth: gum-bleeding.

(v) Skin and nails: Hyperkeratosis, hyper and hypopigmentation, melanosis, exfoliative dermatitis, vitiligo, squamous and basal cell carcinoma, Mee's line.

(vi) Cardio-vascular system: hypertension, arrythmias, myocardial injuries, cold calmmy extremities, peripheral pulsation, blackening of the fingers and toes, vasospasm, gangrene of the lower extremities (Black foot disease).

(vii) Respiratory system: chronic cough, dyspnoea, hemoptysis, bronchitis, abnormal breath sounds.

(viii) Nervous system: Tingling of the skin of extremities, burning sensation, numbness, paresis, paresthesia, polyneuropathy, motor paralysis, foot and wrist drop.

(ix) Gastro-intestinal system: anorexia, nausea, vomiting, stomatitis, colitis, salivation, loose motions, constipation, bleeding piles.

(x) Hepato-biliary system: hepatosplenomegaly, ascitis, non-cirrhotic portal hypertension

(xi) Endocrinal system: diabetes mellitus.

Inorganic arsenicals are well-recognized carcinogens, which cause both skin and visceral malignancies. Though arsenicosis results involvement of different organs, but the most common presenting feature of chronic arsenicosis is skin lesions (90%) [40, 42,43,44,45.]

3.7 OPERATIONAL DEFINITION OF CHRONIC ARSENICOSIS

When we conduct a community-based study we need an operational definition, which is not available for arsenicosis. Therefore we adapted the case definition, which was formulated in a WHO – SEARO regional consultation of arsenic experts. According to this definition arsenicosis is defined as chronic health condition arising from prolonged ingestion (not less than six months) of arsenic above a safe dose, usually manifested by characteristic skin lesion with or without involvement of internal organs. Hyperkeratosis and hyper or hypopigmentation are the characteristic skin lesions [5].

3.8 DIAGNOSIS OF CHRONIC ARSENICOSIS

Diagnosis of chronic arsenicosis is made by history of exposure to arsenic, clinical manifestations and measuring arsenic content in hair, nail, urine and other body tissues like liver. Levels between 0.1 to 0.5 mg/kg on a hair sample indicate chronic poisoning. Normal range of excreted arsenic will be 40.00 – 93.75 micro gm / 1.5 litre/ day. [14,23,46.]

3.9 ESTIMATION OF ARSENIC IN WATER SAMPLE

Spectrophotometric/calorimetric procedure, Atomic absorption spectrometry, Neutron activation analysis, X-ray florescence, Inductively coupled plasma-atomic emission spectrometry, Anodic striipping voltametry, Differential pulse polarography, Hydride generation-atomic absorption spectrometry (HG-ASS), Graphyte furnace atomic absorption spectrometry are different methods available in water sample. In the arsenic mitigation programme, in West Bengal, HG-ASS is

widely used for routine analysis of arsenic in water samples due to better accuracy and lesser cost [23].

3.10 GUIDELINE VALUES FOR ARSENIC STIPULATED BY VARIOUS REGULATORY AGENCIES

Organisation / Country	Maximum permissible level / maximum contaminant level mg / L
WHO, European (1970)	0.05
WHO, International (1971)	0.05
European States Environment Protection Agency	0.05
European community	0.05
Netherlands (1981)	0.2
Former USSR	0.05
Norway	< 0.01
Board of Indian Standards, India	< 0.05

With the view to reduce the concentration of arsenic in drinking water WHO-UN System wide recommended a provisional guideline value of 0.01 mg/L in 1996. The estimated excess lifetime risk of skin cancer associated with exposure to the concentration is $6x10^{-4}$. [1, 23,24,28]

3.11 EPIDEMIOLOGY OF ARSENICOSIS: Global and National

Cases of chronic arsenicosis were reported from the USA (Millard county, Utah, Minnesota, Oregon, California, Alaska regions); Canada (Ontario, Nova Scotia regions); Germany, Hungary, New Zealand; Mexico (Lagunera region); Chile (Antofagasta region); Argentina (Cordoba region); Mongolia; China; Taiwan; Japan (Torku, Nakajo region); Cambodia; Laos; Vietnam; Philippines; Thailand; Myanmar; Bangladesh; India; Nepal; Pakistan; Afganistan and Iran [3,5,6,7,8,14].

In India, arsenic contamination was reported from West Bengal, Bihar and Jharkhand states and Kolkata, Chandigarh and Chennai cities [23,26,42].

3.12 EPIDEMIOLOGY OF ARSENICOSIS IN WEST BENGAL

In West Bengal, nine districts were identified as arsenic contaminated. They are: Malda, Murshidabad, Bardhaman, Nadia, Hooghly, 24 Paraganas North, Haora, Kolkata and 24 Paraganas South.

In West Bengal, research conducted simultaneously from three institutions, namely Institute of Post Graduate Medical Education and Research (IPGMER) led by professor D.N. Guha Mazumder and his team, All India Institute of Hygiene and Public Health (AIIH&PH) led by departments of Public Health Engineering and that of Environmental Studies, Jadavpur University (JU) led by professor D. Chakravarty and his team. These researches indicated increasing environmental pollution and consequent human affection in nine districts of West Bengal by contamination of arsenic, beyond permissible limit, in water sources. These studies estimated prevalence of arsenicosis and arsenical skin lesions to be in the range of 18 to 25%. They also reported pregnant women, children and malnourished were more affected and this disease affected most of the organs and systems of human body with more chance of carcinoma of skin and organs. In most of the cases skin lesions were manifested.[8,9,13,14,15,16,17,18]

In July 1983, the first suspected cases from the village Gangapur, district 24 Parganas, attended the skin outpatient department of School of Tropical Medicine, Kolkata. [47] In 1984, Garai et al published a report of 16 cases of chronic arsenicosis having hyper and hypopigmentation.[48] In 1987 Chakravarty and Saha identified 14 villages in five districts of 24 Parganas, Bardhaman, Nadia, Malda and Murshidabad, having arsenic contaminated ground water. In his study overall prevalence of arsenical dermatitis was 25.1% [47]. From 1988-91, a joint study was carried out by Public Health Engineering Directorate, Government of West Bengal All India Institute of Hygiene and Public Health; Centre for study of Man and Environment; School of Tropical Medicine; State Water Investigation Directorate and Central Ground Water Board. They observed that arsenic above permissible limit is confined within meander belt zone of upper delta plain comprising late quaternary sediments. The water of the intermediate (second) aquifer was polluted. The ground water of arsenic infested zone was characterized by high iron, arsenic, calcium, magnesium and bicarbonate. The pH was always >7. [49]

'Workshop on ground water arsenic contamination for the paramedicals', held in 1996-97 and organized by Public Health Branch of Directorate of Health Services and UNICEF identified 1,65,309 cases of arsenic related skin diseases and 39.33 lakhs population residing in arsenic contaminated areas. [50] Mandal et al analysed 20,000 tube wells water for arsenic and found 45% of them to have arsenic content above permissible limit. [42]

Guha Majumder conducted an epidemiological survey in 1987 in South 24 Paraganas and found 9% of the population consuming arsenic contaminated water had raindrop pigmentation and 4%

had thickening of palm and soles. On the other hand he found 94% rain drop pigmentation, 77% hepatomegaly, 65% thickening of palm and sole, 65% dyspepsia, 63% chronic cough, 44% anemia, 29.8% burning sensation of eyes, 29.4% splenomegaly, 30.24% of chronic obstructive pulmonary disease (COPD) among chronic arsenicosis cases who were admitted to Institute of Post Graduate Medical Education and Research, Kolkata. [51]

In another study in 1988 Guha Majumder again identified chronic arsenical dermatosis and hepatomegaly in 92.5% population consuming arsenic contaminated water. [13]

In 1998, N. Mandal had identified 25% prevalence of arsenical skin lesion in few villages of district 24 Paraganas South 23. In 2003, M.M.Rahaman et al identified 18% arsenical skin lesions in a village of district Murshidabad [16].

3.13 TREATMENT OF CHRONIC ARSENICOSIS

Chelation therapy is widely used in the idea that it will relieve systemic clinical manifestation and reduce arsenic stores in the body diminishing subsequent risk of cancer. Chelating agents like d-penicillamine, dimercaptosuccinic acid (DMSA), dimer captopropane sulphonate (DMPS), antioxidants (spirulina, selenium, zinc and vitamins A, C and E), retinoids (etrotinate), and topical salicylic acid, tretinoic acid, keratolytics and 5-flurouracil are empirically used. [14,23] There are no evidence based treatment regimen to treat chronic arsenicosis, but these agents are reported effective. Arsenic dermatitius is treated with 10% salicylic acid in 10 – 20 % urea based preparation and topical tretinoic acid and 5-flurouoil.

3.14 ARSENIC MITIGATION OPTIONS UNDER JOINT PLAN OF ACTION

The mitigation options, that is, provision of alternative safe water, being considered under the arsenic mitigation programme include:

(1) Piped water supply schemes based on either river or wide diameter deep tube wells.
(2) Construction of deep tube wells to tap water from safe aquifers.
(3) Arsenic removal plants attached to tube wells.
(4) Horizontal Roughing Filters or Slow Sand Filters to treat traditional surface water, namely pond or lake water
(5) Development and distribution of affordable and user-friendly arsenic removal domestic filter;

(6) Sharing safe sources of water in the community and

(7) Rain water harvesting both for individual households and communities. [8]

4. METHODS

4.1 STUDY DESIGN

We conducted a community based cross sectional study.

4.2 STUDY AREA

The study area was Shyampur II block, district Haora, West Bengal, India.

4.3 STUDY POPULATION

According to census of India 2001, the population of Shyampur II block was 0.17 million [12]. Our study population included all the permanent residents of 165 villages in Shyampur II block.

4.4 INCLUSION CRITERIA

All permanent residents of Shyampur II block, who were selected and who, would voluntarily like to participate in the study.

4.5 EXCLUSION CRITERIA

All temporary residents of Shyampur II block and those who had taken water from their sources less than six months. Children below five years were excluded from knowledge, attitude and practice part of the study.

4.6 SAMPLING FRAME AND SAMPLING UNIT

Sampling frame consisted of 165 villages of Shyampur II block. Our sampling unit was selected households of each village.

4.7 SAMPLING PROCEDURE

We assumed the prevalence of arsenicosis was 18%, based on a recent study conducted in a district of West Bengal [16]. We considered confidence interval $\pm$4% and confidence co-efficient 95%. The total sample size was 356. Allowing for a non-response of 10%, the sample size became 392. Assuming a design effect of 2, the total sample size needed was 785. Assuming 5 persons reside in each household, 157 (~ 160) households were to be surveyed. We proposed to select 10 households

from 16 clusters (160 households) [20,30]. We calculated design effect after the survey was over. This design effect was used for constructing 95% confidence interval for various point estimates.

4.8 SAMPLE SIZE

We used cluster-sampling technique. Each village was considered as a cluster. We selected them using probability proportional to size technique. Our sample size was 785. Assuming average five persons reside in each household, we had to select 160 households for our survey. Then we distributed those 160 households among 16 selected villages, having 10 households in each village. In each cluster, we selected households using the electorate enumeration list by simple random sampling frame [Appendix vi].

4.9 STUDY TEAM AND TRAINING OF THE TEAM

We formed five teams. Each team consisted of one medical officer, one first tier supervisor, one health supervisor and two female multi-purpose health workers. The principal investigator was included in a team. Health personnel of respective areas were preferred for better acceptability. I explained the purpose of the study in the monthly meeting in presence of the Block Medical Officer of Health, Shyampur II block. I selected the team members from the health personnel consulting with the Block Medical Officer of Health and trained the team members with the data collection instrument. Then we jointly chalked out our survey programmes.

4.10 STUDY PERIOD

Plan of action	Time-frame
Literature search, framing research question, preparation and submission of concept paper	June, 2005
Preparation, peer review, revision and submission of protocol for ethical clearance	July, 2005
Planning, preparation, training and pilot study.	August 2005
Field visit and data collection.	September & October'05
Data analysis and report writing.	November 2005
Submission of report	December 2005

4.11 DATA COLLECTION

We used a pre-designed and pre-tested schedule (data collection instrument) for house-to-house survey. The trained field investigators went to all the recruited households and explained the purpose and procedure of the study. They maintained confidentiality of the data collected. We collected data of children from their parents or guardians. We excluded children below 5 years from knowledge, attitude and practice part of the study. We measured height by standing in front of wall (anthropometric rod was not available) and weight by weighing machine. We estimated body mass index of participants aged 18 years and above and measured weight per height for below 18 years ages to detect malnutrition. We collected water samples and sent them to the UNICEF-accredited water-testing laboratory at 'Anandaniketan', Bagnan, for estimation of arsenic level by flow-injection hydride generation atomic absorption spectophotometry.

4.12 DATA ANALYSIS

We calculated point estimates and 95% confidence interval (95% CI) of prevalence of chronic arsenicosis, level of knowledge, attitude and practice about arsenicosis.

4.13 QUALITY ASSURANCE

The protocol and data collection instrument, were reviewed by the faculty and peer groups. We also consulted with the experts. We discussed about the practical problems of the field and arranged logistics before the survey. We also reviewed the progress of the survey after each day's work. The principal investigator validated a tenth of interviews through observations of field procedures of data collection for quality assurance and consistency.

4.14 HUMAN SUBJECT PROTECTION

I submitted my protocol to the institutional ethics committee of National institute of Epidemiology in July 2005. The protocol was scrutinized and accepted. We distributed 'information sheet' to each participant and explained the objectives and procedures of the study in presence of an eye-witness. They were informed about both risks and benefits of the survey. Their participation was completely voluntary and their confidentiality was maintained carefully. We obtained signed informed consent from the participants before starting of the survey. The survey included vulnerable population, namely, children, adolescents, pregnant women and elderly persons. [18,22]

The information sheet and informed consent form were written in lay-person's language describing clearly the purpose, duration and merit of the survey. Right to question, to refuse any question, to discontinue and to withdraw, irrespective of getting routine facilities, were also clearly written. We decided before the survey that if someone would not want to participate in the survey, we would counsel him or her before our second attempt, but would never put on coercion. We shared the result of the survey and water analysis. We offered free investigation and treatment of arsenicosis to suspected patients. We had also provision for evaluation of the cases to confirm their diagnosis and to initiate proper treatment and mitigation. But we clearly explained to the participants of the survey that we had no fund for providing their conveyance and compensation of wages.

Our medical officers with the teams treated minor health problems of the participants at the time of survey. The team along with local health personnel rendered health education to them particularly on prevention and mitigation of arsenicosis. They suggested to the participants to attend the weekly arsenic clinic, held on every Friday at Jhumjhumi block primary health centre, whenever they require.

4.15 OPERATIONAL DEFINITIONS

Arsenicosis: Arsenicosis results in multi-system disease, manifesting predominantly as skin lesions like hyperkeratosis, hyper or hypopigmentation, exfoliative dermatitis and Mee's line [14,15,16,17,18,19,21,22,23,24,25,29]. However a standard case definition is not available. Hence it might not be appropriate to compare prevalence estimates from different epidemiological studies conducted in arsenic contaminated areas. In November 2002, WHO – SEARO, convened a regional consultation of arsenic experts, to formulate a standard case definition of arsenicosis [5]. We used this definition in the present study.

According to the WHO-SEARO guidelines, arsenicosis is defined as chronic health condition arising from prolonged ingestion (not less than six months) of arsenic above a safe dose, usually manifested by characteristic skin lesion[#] with or without involvement of internal organs [5].

Hyperkeratosis: Diffuse bilateral thickening of palms and/or soles with or without nodules of various shapes and sizes.

Hyper or hypopigmentation: Rain drop shaped discoloured spots with or without diffuse darkening of the skin in trunks and limbs.

Mee's line: Transverse striae of finger and nails.

[#] Hyperkeratosis and hyper or hypopigmentation.

Exfoliative dermatitis: Red scaly skin lesion.

Gangrene: Fulminating ulcer with bad odour.

Mitigation: Moderation, that is, the action of lessening in severity or intensity [61].

Maximum permissible limit of arsenic in drinking water: Water source containing arsenic is not more than 0.05 milligram / liter as per Bureau of Indian Standards.

Provisional guideline value: WHO-UN System wide recommended a provisional guideline value of arsenic in drinking water, which is 0.01 mg/liter.

4.16 DEFINITIONS OF VARIABLES

Below Poverty Line (BPL): Income less than Rupees 228 / capita / month in rural area [52,54].

Body Mass Index (BMI): Weight in kilogram divided by height^2 in meter in 18 years and above. Normal range is 18.4 to 24.9 [52,53].

Anaemia: Clinically observed moderate to severe pallor in lower palpabral conjuntiva.

Generalized weakness: Feeling fatigued all the time in age group less than 60 years.

Oversweating: Excessive perspiration without exertion.

Chronic cough: Persistant cough more than 15 days.

Dyspnoea: Exertion at the time of breathing.

Tingling: Needle pricking sensation. [43]

Numbness: Loss of sensation and feeling of heaviness in the affected part. [43]

Anorexia: Chronic loss of appetite.

Hepatomegaly: Liver 1 or > 1 finger palpable below right costal margin. [43]

Splenomegaly: Spleen 1 or > 1 finger palpable below left costal margin. [43]

Ascitis: Retention of fluid in the abdomen.

Malnutrition: Measured by weight per height [52,56].

5. RESULTS

We surveyed 767 participants out of 785 eligible participants (98%). The non-respondents were not different from respondents by age and gender [Table 1]. Age and gender distribution of the sampled population was similar to the population of the block [Table 2].

5.1 SOCIO-DEMOGRAPHIC CHARACTERISTICS

Among 767 participants, 468 (62%) were in the 15 to 49 years age group. Males were 406 out of 767 participants (53%)[Table 1]. Participants below poverty line were 272 out of 767 (35%)[Table 3]. High school goers, 301 out of 704 (43%), were higher than other groups and illiterate were 112 out of 704 (16%)[Table 4]. Proportion of participants employed in resource generation, were 256 out of 767 (33%)[Table 5]. Agricultural labourers were higher among them, 113 out of 767 (15%)[Table 5]. Median length of stay of the participants, were 27 years.

5.2 WATER INTAKE HISTORY

Tube wells were the sources of drinking and cooking water of 733 participants out of 767 (96%), either as single source (38%) or along with pond (58%)[Table 6]. Apart from tube wells, other sources used, were: pond (2%), river-canal (1%) and pipe line (1%). Median duration of water consumption from tube wells, as reported by the participants, was 22 years and average daily consumption of water was 2 liter.

5.3 ARSENIC LEVEL IN TUBE WELL WATER

Water samples from 426 tube wells, which were installed by government agencies, were analysed. Arsenic content in 87% samples were below detection level. Arsenic content in 13% samples were below 0.01mg/L [Table 7].

5.4 DERMATOLOGICAL AND NAIL EXAMINATION

We identified 2 out of 767 participants with diffuse bilateral thickening of palms and soles (hyperkeratosis). Hence, prevalence of arsenicosis is 2.6 per 1000 population (95% Confidence Interval: 0.5-9).

5.5 NUTRITIONAL ANTHROPOMETRY

Most of the adults (166/536, 69%), had body mass index within normal range. Normal range is 18.4 to 24.9 [52,53]. We observed 15 out of a total of 232 (6%) participants in age group of 0 to 14 years had been suffering from malnutrition [Table 8].

5.6 PHYSICAL EXAMINATION

Among the participants 40 out of a total of 767 (5%) had moderate to severe degree anemia, 20 out of 718 (3%) had generalized weakness and 9 out of 767 (1%) had suffering from over sweating [Table 9].

5.7 OTHER SYSTEMIC EXAMINATION

Other arsenicosis related clinical manifestations were observed in small number. Among the participants, 26 out of a total of 767 (3%) had anorexia and splenomegaly, 2% had constipation (n=17) and hepatomegaly (n=18) and 1% had tingling (n=7), burning sensation (n=6), numbness (n=7), bleeding piles (n=11), diarrhea (n=9) and ascitis (n=4) [Table 9].

5.8 KNOWLEDGE ABOUT ARSENICOSIS

We observed 266 out of a total of 704 (38%) (95% CI: 34 – 41) knew about arsenicosis and 35 (5%; 95% CI : 4–7) had knowledge about role of nutritious diet. Among 704 participants, 671(95%;95% CI: 94 – 97) knew that arsenicosis is not contagious and 629 (89%; 95% CI 87 – 91) told that it is essential to seek medical care if one suffers from arsenicosis. Almost 50% participants were not aware of whether water samples were ever taken for estimation of arsenic content [Table 10, 11].

5.9 ATTITUDE TOWARDS ARSENICOSIS

We observed that 561 out of 704 (80%) (95% CI: 77 – 82) agreed to abandon the sources if they became contaminated. Out of 704 participants, 529 (75%) (95% CI: 72 – 78) would seek medical help when symptoms appeared. 481 (68%) (95% CI: 65 – 72) stated that they would agree to share their water sources with others, when others' water sources became contaminated [Table 10,11].

5.10 PRACTICE ON ARSENICOSIS

We observed that 324 out of a total of 704 (46%) (95% CI: 42 – 50) participants responded positively when they were asked whether they would agree to test their water sources for arsenic estimation. Among 704 participants, 218 (31%) (95% CI: 28 – 34) said that they participated with awareness generation programme on arsenic and 571 (81%) (95% CI: 78 – 84) told that the health workers talked on arsenicosis during their home visits. Among 704 participants of the survey 673 (90%) said that if required they would avail the facilities of arsenic clinic (95% CI: 88 – 92).

6. DISCUSSION

We conducted a cross-sectional study to estimate the prevalence of arsenicosis in the block. The prevalence was very low (3 per 1000 population) as opposed to what we set out to estimate in the sample size calculation. Studies from Matlab area of Bangladesh reported exactly same level of prevalence of arsenical skin lesions. Our calculation of sample size was based on 18% prevalence of arsenical skin lesions. This estimate is based on a recent study conducted in another arsenic contaminated district in West Bengal [16]. Other published studies of the state indicated 18 to 25% prevalence [15,23,47]. We adapted WHO-SEARO definition of arsenicosis in absence of any uniform community based definition.

The findings suggested that Shyampur II block is not an arsenic contaminated block. There could be several reasons for this finding. Firstly, Shyampur II might not be an arsenic contaminated block. Secondly, it might a block with low prevalence of arsenicosis (prevalence between <1 to 5%). Thirdly, prevalence level might have come down due to prolonged health education activities under the mitigation programme. Finally, we could not find any significant inter-cluster variation since the design effect was less than one. This might be due to that fact we identified small number of suspected arsenical lesions in the survey. Participation level of the survey was high, which suggested the internal validity of the study. We also observed that sampled population and study population were similar in age and sex wise distribution. This fact strengthened the external validity of the study. We recommend further studies with larger sample size to estimate the to establish the fact that whether our study finding was an artifact or a real one.

We observed few clinical manifestations, which might occur in arsenicosis and also in other diseases, in small percentages (1 to 3%).

Most of the participants used tube well as the source of drinking water, singly or with others sources. We did not observe any contaminated sample from the tube wells. Public Health Engineering Department and Panchyet Samity informed us that they laid all tube wells inside safe aquifer layer. But we did not know about the tube wells installed by voluntary organizations and individuals. The result suggested that arsenic content was below permissible limit in all water samples collected from 426 tube wells, installed by government agencies. Here we did not find any contamination of water source by arsenic with above permissible limit. Report of arsenic clinic, located at block primary health centre did not record any case of arsenicosis, either diagnosed or referred to the next referral unit (appendix viii).

The result indicated that knowledge about arsenicosis was mixed in nature. Most of the participants did not believe that arsenicosis was contagious, felt it was essential to seek medical care in arsenicosis and knew about the arsenic clinic. At the same time, a small proportion knew nutritious diet prevents and restricts arsenicosis, knew the symptoms and knew the causes of disease. This might be due to presence of a large proportion of poor, illiterate and unemployed participants, including a large proportion of housewives, population not employed gainfully and small children.

The result indicated that their attitude were better than their knowledge level. Most of the participants would abandon the sources when they became contaminated. They would seek medical help when symptoms appeared and agreed to share their sources of water with others. This could be due to regular counseling by the health personnel and organization of awareness programmes.

The result indicated that practice about arsenicosis was also mixed in nature. Most of them used safe water sources and would like to attend in arsenic clinic when required. But a lesser proportion ever interacted with any awareness programme on arsenicosis or would like to test their water sources. Awareness programme did not cover all the villages (identified in programme evaluation), which might be the cause of some poor practice on arsenicosis.

The study suffered from a number of limitations: First, we examined water samples of all government installed tube wells for estimation of arsenic content, but we could not examine water samples of other tube wells and other sources of drinking and cooking water. Second, chronic arsenicosis is a slow progressing disease and it is very difficult to diagnose. Here we conducted a cross-sectional study in a point of time. Therefore chance was there to miss diagnosis of cases.

7.CONCLUSION

The survey did not corroborate with any florid case of arsenicosis, only <1% suspected arsenical lesion was identified. Water samples from the tube wells showed arsenic level to be well below the permissible limit.Among the participants, attitude on arsenicosis was satisfactory, but knowledge and practice on arsenicosis were not satisfactory.

8. RECOMMENDATIONS

On the basis of the results of the study we proposed the following recommendations:

- Further study with larger sample size is required to estimate prevalence and factors associated with arsenicosis in Shyampur II block, district Haora, West Bengal
- The arsenic mitigation programme needs to analyse water from individually installed tube wells, ponds, river-canals and pipe-line water sources to exclude contamination of these sources
- The health care workers need to sustain with a wider coverage of health education activities on prevention of arsenicosis in the block.

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10. FIGURES AND TABLES

Figure 1: Study area. Shyampur II block, Haora, West Bengal, India, 2005

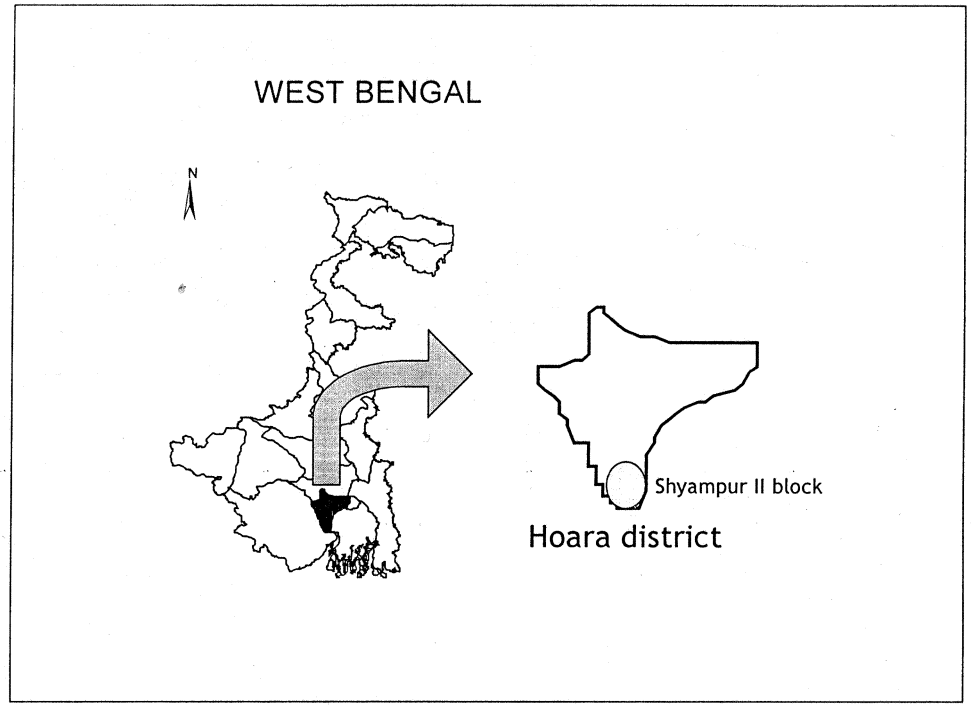

Table 1: Comparison of respondents and non respondents by age and sex, Shyampur Block II, district Haora, West Bengal, India, 2005

Characteristics		Respondents		Non respondents	
		#	%	#	%
Age	< 15 years	458	60	11	60
	≥ 15 years	309	40	7	40
Sex	Male	406	53	10	55
	Female	361	47	8	45
Total		767	100	18	100

Table 2: Comparison of sample (n=785) and target population (n=1,72,856) by age and sex, Shyampur Block II, District Haora, West Bengal, India, 2005

Characteristics		Sample population		Target population (Shyampur Block II)	
		#	%	#	%
Age	0 – 4 years	63	8	14,000	8
	5 –14 years	169	22	41,000	24
	15 – 59 years	468	64	107,000	62
	≥ 60 years	49	6	10,000	6
Gender	Males	406	53	90,000	52
	Females	361	47	82,000	48
Total		767	100	172,000	100

Table 3: Respondents by income, Shyampur Block II, district Haora, West Bengal, India, 2005

Income level	#	%
Above poverty line	495	65
Below poverty line	272	35
Total	767	100

Table 4: Respondents by level of education (5 years and above) (n = 704), Shyampur Block II, district Haaora, West Bengal, India, 2005

Education level	#	%
Illiterate	112	16
Primary	217	31
Secondary	301	43
Graduate	74	10
Total	704	100

Table 5: Respondents by occupation Shyampur Block II, district Haora, West Bengal, India, 2005

Occupation	Individuals	
	#	%
Labour	113	15
Cultivator	55	7
Service	40	5
Business	48	6
Student	174	23
Housewife	204	27
Not employed gainfully including children under 5 years of age	133	17
Total	767	100

Table 6: Respondents by water intake status, Shyampur Block II, district Haora, West Bengal, India, 2005

Sources of water intake	Number of respondents taking water from the source	Total	%
Tube well and pond	445	767	58%
Tube well	228	767	38%
Pond	15	767	2%
River-canal	11	767	1%
Pipeline	8	767	1%

Table 7: Prevalence of arsenic contamination, Shyampur Block II, district Haora, West Bengal, India, 2005

Arsenic in tube well water	#	Total	%
Arsenic below detection level	371	426	87
Arsenic detected but < 0.01 mg/L	55	426	13

Table 8: Respondents by nutritional status, Shyampur Block II, district Haora, West Bengal, India, 2005

Nutritional status	#	Total	%
Clinically observed anaemia ++ to +++	40	767	5
BMI not within normal range (18 years and above)	166	536	31
Malnutrition (up to 15 years)	15	767	2

Table 9: Prevalence of clinical illness (signs/symptoms) among study participants, Shyampur Block II, district Haora, West Bengal, India, 2005

Clinical illness (signs/symptoms)	#	Total	Prevalence (%)
Generalized weakness below 60 years	20	718	3
Over sweating without exertion	9	767	1
Chronic cough (> 3 weeks)	1	767	<1
Dyspnoea	3	767	<1
Pain in finger tip on exposure to cold	2	767	<1
Cold clammy extremities	2	767	<1
Peripherial pulsation	2	767	<1
Tingling	7	767	1
Burning sensation	6	767	1
Numbness	7	767	1
Anorexia	26	767	3
Loose motion	9	767	1
Constipation	17	767	2
Bleeding piles	11	767	1
Hepatomegaly	18	767	2
Splenomegaly	26	767	3
Ascitis	4	767	1

Table 10: Prevalence of knowledge, attitude and practice about arsenicosis among study participants (n=704), Shyampur II block, district Haora, West Bengal, India, 2005

Characteristic		#	Prevalence (%)	95% Confidence interval
Knowledge	Knew the disease arsenicosis	266	38	34 - 41
	Knew symptoms of arsenicosis	154	22	19 - 25
	Knew causes of arsenicosis	247	35	32 - 39
	Did not belief arsenicosis is contiguous	671	95	94 - 97
	Knew nutritious diet prevent arsenicosis	35	5	4 - 7
	Knew about arsenic clinic	426	61	57 - 64
	Essential to seek medical care if one suffers	629	89	87 - 91
Attitude	Would seek medical care when symptoms appeared	529	75	72 - 78
	Should not ostracize arsenicosis patient	408	58	54 - 61
Practice	Interacted with awareness programme	218	31	28 -34
	Would attend arsenic clinic, if required	637	90	88 - 92

Table 11: Prevalence of knowledge, attitude and practice about arsenic contamination among study participants (n=704), Shyampur II, district Haora, West Bengal, India, 2005

Characteristics		#	Prevalence (%)	95% Confidence interval
Knowledge	Knew contamination to be determined by water test	60	8	7 - 11
	Knew water, they used, was safe	341	48	45 - 52
	Feedback of report from government personnel	176	25	22 - 28
	Accessibility to alternate source	115	16	14 - 19
Attitude	Abandon water source if contaminated	561	80	77 - 82
	Seek alternate source if contaminated	464	66	62 - 69
	Share water with others	481	68	65 - 72
Practices	Agree to test water source	324	46	42 - 50
	Used safe water	449	64	60 – 67

11. APPENDIX

(i) Document Mission of 'JOINT PLAN OF ACTION' by Government of West Bengal (GoWB) and UNICEF
(ii) Patient information sheet
(iii) Informed consent form
(iv) Data collection instrument
(v) Budget submitted
(vi) List of sixteen villages of Shyampur II block, district Haora, West Bengal, which were selected by probability proportional to size technique in cluster sampling for survey from April to May 2005.

(i) Document Mission of 'JOINT PLAN OF ACTION' by GOWB and UNICEF:

a) OBJECTIVES OF 'JPOA' IN WEST BENGAL

1. To focus attention through appropriate and accurate information by
    a. Outlining the arsenic problem, its existence, impacts, spread and challenges encountered in tackling it.
    b. Stressing on a revised concept of safe water - not just bacteria free but arsenic free too. This will involve a campaign to create awareness of the presence of arsenic above permissible limits in large number of tubewells
    c. Dispelling myths and misconceptions that surround arsenicosis using scientifically sound information delivered through appropriate communication packages that are target specific.
    d. Providing information regarding mitigation measures (both alternative water supply and preventive, promotive and supportive health measures) by government and non governmental agencies, with special emphasis on the Joint Plan of Action (JPOA) undertaken by GOWB and UNICEF to address the high arsenic content in ground water. [8,9]

2. To arouse interest that would –
    a. Create sufficient awareness among people to motivate owners of private tubewells to voluntarily seek regular testing of their tubewells for arsenic and if needed, opt for safer alternatives.
    b. Help initiate studies for creating reliable and easily accessible database.
    c. Identify areas for research into various aspects of arsenic toxicity.
    d. Evoke greater involvement from NGOs, funding organizations, academicians, researchers etc.
    e. Inspire wider community participation in the awareness, training and mitigation campaigns.
    f. Involve the media in dissemination of reliable and welldocumented information. [8]

b) PROVISION OF ARSENIC FREE WATER FOR THE COMMUNITY.

The joint study carried out by different nodal organizations during 1988-1991 recommended following measures:

i) Only the deep (third) aquifers should be tapped for drinking water purposes.
ii) The water sample of a newly installed tubewell to be tested carefully before it is commissioned.
iii) The yield from the third aquifer should be regulated to avoid vertical leakage of arsenic rich water from the affected layer invading to the third layer.
iv) A system of periodic monitoring of arsenic content in the tubewell is to be introduced.
v) Supply of treated surface water.
vi) Installation of arsenic removable plants and they are to be attached to hand pumps in arsenic contaminated areas
vii) Rainwater harvesting by digging of large ponds in arsenic contaminated villages to store rainwater.
viii) Sharing of safe water sources among villagers.

(ii) Patient information sheet:

Name of the principal investigator: Dr. Gaurab Roy

Name of the organization: Directorate oh Health Services, Government of West Bengal

Collaborating organizations: National Institute Cholera and Enteric Diseases, Kolkata and National Institute of Epidemiology, Chennai.

Namaskar,

I, ..., a colleague of Dr. Gaurab Roy, district-level monitoring officer of Shyampur II block, district Haora, from the department of Health and Family Welfare, Government of West Bengal, with my team, comprising Medical Officer, Public Health Nurse, Health Supervisor and Multipurpose Health workers of Jhumjhumi Block hospital, would like to find out the problem of arsenic contamination of drinking water in Shyampur II block. We would like to determine the number of water sources contaminated and number of people affected. We would also like to assess the awareness of the people about arsenic related health problems and its prevention. This information will enrich the ongoing arsenic mitigation programme of the block.

We will ask you some questions and our Medical Officer will examine you if you have any arsenic related health problem. Taking part in the survey is voluntary. You can choose not to participate. You can choose not to answer a specific question or can stop answering the questions at any time without giving any reason or can choose not to be examined. This will not affect your right to routine health facilities offered by the department of health and family welfare. However, taking part in the survey eventually benefit you and your community.

We will also request you to provide water samples used by you for drinking and cooking purposes. One UNICEF approved laboratory at 'Anandaniketan', Bagnan, will be testing the water for arsenic content. We will inform you the result, whatever it may be as and when we receive it from the laboratory. Examination of water sample does not necessarily mean the source is contaminated. Further, drinking contaminated water does not mean you have the disease.

Arsenic related health problem could be easily prevented if you drink safe water. Arsenic related health problem can be treated free of cost in government hospitals. If the medical officer suspects

that you may have arsenic related health problem, we will refer you to arsenic clinic at Jhumjhumi block hospital (Friday from 9 am to 2 pm)). If necessary the medical officer will refer you to arsenic clinic of SSKM Hospital (Thursday from 2 pm to 4 pm), Kolkata for investigations and further management. Treatment and investigations will be done free of cost, the only thing you have to do is to reach the arsenic clinic at your own cost. We are not in a position to offer you compensation for loss of pay on account of your attendance at the arsenic clinic for this purpose.

If you wish more about the survey you may contact in the following telephone numbers: (1) Block Medical Officer oh Health, Jhumjhumi BPHC – 261296 (Monday to Friday: 9 AM to 4 PM & Saturday: 9 AM to 2 PM); (2) Dr. Gaurab Roy - 24015370 (anyday from 8 PM to 10 PM).

Thanking you, ...

Dated: (Signature)

Place: Jhumjhumi BPHC, district Haora

(iii) Informed consent forms:

a) Informed consent form for adults

Serial Number: Dated:

Patient's identification number:

Name of investigator:

I, ..., son of / daughter of / wife of ..... and resident of village ..... of panchayet ..... have read the foregoing informations / it has been read to me on ..... .

The informations are about the house- to- house survey to determine the arsenic related health problems, contamination of water sources by arsenic and awareness about arsenic related health problems and its prevention.

I have been told the purpose of the survey and also told that if suspected to have arsenic related health problem, I would be examined by a medical officer for diagnosis.

I have been told about that I have had the opportunity to ask questions about it and any questions I have asked have been answered to my satisfaction. I consent voluntarily to participate as a subject in this survey and understand that I have the right to withdraw from the study at anytime without in any way it affecting my further medical care.

I do not claim money or compensation of wages for participating in the survey and to attend arsenic clinics when required.

Dated: (Signature)

OR

(Signature of a literate witness) (left thumb impression)

Dated: (Countersignature of the investigator)

b) Informed consent form for children

Serial number: Dated:

Patient's identification number:

Name of investigator:

My minor son / daughter named ..... aged ..... has been invited to participate in the house to house survey
to determine the arsenic related health problems, contamination of water sources by arsenic and awareness about arsenic related health problems and its prevention.

I have been told the purpose of the survey and also told that if my son / daughter is suspected to have arsenic related health problem, he / she would be examined by a medical officer for diagnosis.

I have been told about that I have had the opportunity to ask questions about it and any questions I have asked have been answered to my satisfaction. I consent voluntarily to allow my son / daughter to participate as a subject in this survey and understand that I have the right to withdraw him / her from the study at anytime without in any way it affecting his / her further medical care.

I do not claim money or compensation of wages for participating of my ward in the survey and to attend arsenic clinics when required.

Dated:

(Signature)

OR

(signature of a literate witness) (left thumb impression)

Dated: (Counter signature of investigator)

(iv) Data Collection Instrument:

'Data Collection instrument' for prevalence, knowledge, attitude and practice about arsenicosis and arsenic contamination in water sources in Shyampur II block, district Haora, West Bengal,2005

Form A

Identifiers' collection form:

(To ensure confidentiality, identifiers' will not be collected in the paper questionnaires)

Household ID:		Name of the chief of the household:			
Household address: Household number: Name of the village: Name of the sub-centre: Name of the panchayet:					
ID1 name:		ID5 name:		ID9 name:	
ID2 name:		ID6 name:		ID10 name:	
ID3 name:		ID7 name:		ID11 name:	
ID4 name:		ID8 name:		ID12 name:	

Form B

Household data collection form (for each household member):

Household ID:	Team No:
Number of the persons to be interviewed (to be tallied with Form A):	

Socio-demographic characteristics:

Questionnaires items	**Options**		**Coding (for entering the response in code)**
Age		(In completed years; in children <1year in completed months)	
Sex	1. Male	2. Female	
Literacy level (5 years and above)	1. Illiterate 2. Primary	3. High 4. College	
Occupation	1. Labour 2. Cultivator 3. Service 4. Business	5. Student 6. Housewife 7. Not employed gainfully including 1 children under 5 years	
Income	1. Below poverty line 2. Above poverty line	(BPL < Rupees 228 / per capita / per month in rural area)	
Duration of residence		(In completed year)	

Anthropometry:

Weight		(In kilogram)	
Height		(In centimeter)	

Water intake history:

Sources of drinking water:			
1. Tubewell	1. Yes	2. No	
2. Pond	1. Yes	2. No	
3.River / Canal	1. Yes	2. No	
4. Pipeline	1. Yes	2. No	
5. Others (specify)	1. Yes	2. No	
Duration of water intake from the source:			
1. Tubewell	-------	Years	
2. Pond	-------	Years	
3. River / Canal	-------	Years	
4. Pipeline	-------	Years	
5. Others (specify)	--------	Years	
Amount of consumption of water:			
Daily water intake		Glasses (one full glass contains approximately 250 milliliter)	
Analysis of water, used for drinking and cooking purposes, for estimation of arsenic content:			
Whether water is taken from the source for laboratory estimation of arsenic content	1. Yes	2. No	3. Do not know

Physical examination:

Items	Options		Coding
General:			
Anaemia (Pallor ++ to +++ in lower palpabral conjuntiva)	1. Present	2. Absent	
Jaundice (Yellow colour in the upper palpabral conjuntiva)	1. Present	2. Absent	
Clubbing (Abnormal bending of nails)	1. Present	2. Absent	
Non-pitting oedema (swelling around the ankle joint)	1. Present	2. Absent	
Generalized weakness (Feeling fatigued all the time) below 60 years age group	1. Present	2. Absent	
Oversweating (Excessive perspiration) without any exertion	1. Present	2. Absent	
Dermatological and nail examination:			
Hyperkeratosis (Diffuse bilateral thickening of palms / soles with or without nodules of various shapes and sizes [5])	!. Present	2. Absent	
Hyper or hypo-pigmentation (Rain-drop shaped discoloured spots with or without diffuse darkening of the skin in trunks and limbs [5])	1. Present	2. Absent	
Exfoliative dermatitis (Red scaly lesions)	1. Present	2. Absent	
Gangrene (Fulminating ulcer with bad odour)	1. Present	2. Absent	
Mee's line (Transverse white straie of finger nails [43])	1. Present	2. Absent	
Examination of eyes:			
Conjuntival congestion (Redness of the eye)	1. Present	2. Absent	
Respiratory system:			
Chronic cough (Excessive cough persists > 15 days)	1. Present	2. Absent	
Dyspnoea (Exertion at the time of Respiration}	1. Present	2. Absent	
Haemoptysis (Bleeding with cough)	1. Present	2. Absent	
Abnormal breath sounds (Crepitation, ronchi)	1. Present	2.Absent	

Cardiovascular system:			
Pain in finger tips on exposure to cold	1. Present	2. Absent	
Cold and calm extremities	1. Present	2. Absent	
Peripheral pulsation	1. Present	2. Absent	
Blackening of toes and fingers	1. Present	2. Absent	
Vasospasm*	1. Present	2. Absent	
Nervous system:			
Tingling (Needle pricking sensation [43])	1. Present	2. Absent	
Burning sensation	1. Present	2. Absent	
Numbness (Loss of sensation and feeling of heaviness in the affected part [43])	1. Present	2. Absent	
Paresis (A motor deficit characterized by weakness which is mild to moderate [43])	1. Present	2. Absent	
Paresthesia (Tingling and other abnormal sensation except pain sensation [43]),	1. Present	2. Absent	
Gastrointestinal system:			
Anorexia (Chronic loss of appetite)	1. Present	2. Absent	
Loose motions (Frequent passing of loose stool > 3 times / day)	1. Present	2. Absent	
Constipation	1. Present	2. Absent	
Malena (Altered blood mixed with Stool)	1. Present	2. Absent	
Bleeding piles	1. Present	2. Absent	
Hepatobilliary system:			
Hepatomegaly (Enlargement of liver, i.e., 1 or >1finger palpable below the right costal margin [55])	1. Present	2. Absent	
Splenomegaly (Enlargement of spleen, i.e., 1 or >1 finger palpable in the left costal margin [55])	1. Present	2. Absent	
Ascities (Retention of fluid in the abdomen)	1. Present	2. Absent	

* Intermittent claudication or pain in limbs brought on walking after a few steps and relieved by rest. Rest pain occurs in severe cases. Coldness, numbness, paraesthesia and colour changes (Purple, red sparking and blanching), gangrene, ulceration, paralysis and absent arterial pulsation in dorsalis pedis, posterior tibial, popliteal, femoral, abdominal aorta, carotid arteries and radial arteris [43].

History of present illness:

Malnutrition[#]	1. Present	2. Absent	
Known diabetic	1. Yes	2. No	

Knowledge about arsenicosis:

Do you know a disease called arsenicosis?	1. Yes	2. No	
If yes, what are the symptoms of arsenicosis?	1. Skin lesion 3. Others (specify) 4. 1 & 2	2. Loose motions 5.Do not know	
Do you know where arsenic does persist?	1. Water 3. Soil 5. Do not know	2. Air 4. Food	
Do you know how arsenicosis is developed? Excessive arsenic intake from ----	1. Water 3. Soil	2. Air 4. Food	
Is it a contagious disease?	1. Yes 3. Do not know	2. No	
Do you know what restricts arsenicosis?	1. Good health 3.Exercise	2. Nutritious diet 4. Do not know	
Is it essential to seek care if one suffers from arsenicosis?	1. Yes 3. Do not know	2. No	
Is the water, you are using, safe?	1. Yes 3. Do not know	2. No	
How do you know that?	1. Assumption 3. Report of water testing	2. Listening from others	
Have you any alternative safe source of water?	1. Yes 3. Do not know	2. No	

[#] Malnutrition measured by weight per height below 18 years and BMI 18 years and above.

Attitude on arsenicosis:

If a source is contaminated then what is to be done?	1.Wait and watch 3. Continue	3. Abandon 4. Do not know	
If one suspects that he / she developes symptoms of arsenicosis, then what is to be done?	1. Wait and watch 3. Consult with doctor	2.Continue as it is. 3.Do not know	
What is to be done if the water, you are using, is identified arsenic contaminated?	1. Seek alternatve source of water.	2.Does not seek. 3.Do not know	
If one develops symptoms of arsenicosis he / she should not be ostracized?	1. Yes	2.No 3.Cannot decide	

Practice on arsenicosis:

Is the water, you are using, is tested for estimation of arsenic content?	1. Yes	2.No 3.Do not know	
Are you using a safe source of water?	1. Yes	2.No 3.Do not know	
Have you ever interact with an awareness generation programme in your community for arsenic problem?	1. Yes	2.No 3.Do not know	
Do the health workers talk about arsenicosis during their home visit?	1. Yes	2.No 3.Do not know	
Is there any arsenic clinic in your locality?	1. Yes	2.No 3.Do not know	
If yes, do you avail the clinic?	1. Yes	2.No 3.Do not decide	

(iv) Budget submitted with the protocol

Remunaration of the staffs	Rs. 6000.00
Hiring vehicles	Rs. 6000.00
IEC	Rs. 2000.00
Stationaries and xerox	Rs. 1000.00
Training of the staff	Rs. 500.00
Total	Rs15500.00

(v) List of sixteen villages of Shyampur II block, district Haora, West Bengal, which were selected by probability proportional to size technique in cluster sampling for survey from April to May 2005.

Cluster No.	Name of the village	Population	Subcentre	Gram Panchayat
1.	Dihimandalghat	5853	DMGhat	DM Ghat I
2.	Paltaberia	2917	Jhumjhumi	DM Ghat II
3.	Gujar Ajodhya	535	Antilapur	DM Ghat II
4.	Sultanpur	2526	Ramnagar	Sasati
5.	Sitapur-Dhantala	1532	Sitapur	Amardaha
6.	Tajnagar	1238	Amardaha	Amardaha
7.	Kharuberia	1114	Kharuberia	Kharuberia
8.	Khiderpur	1750	Naskarpur	Kharuberia
9.	Mamudpur	1708	Gobindapur	Kharuberia
10.	Garchumuk	2782	Bargarchumuk	Bargram
11.	Ganeshpur	1166	Banamali nagar	Bargram
12.	Jagadishpur	2190	Naul	Nakale
13.	Gopinathpur	2193	Gopinathpur	Nakole
14.	Malipur-Masha	712	Kantagachi	Nakole
15.	Rana	1087	Palgoria	Bachri
16.	Osmanpur	1293	Mohanpur	Bachri