

Health and Nutritional Anthropometry of Arsenicosis affected people: A cross sectional study at Gaighata Block, North 24 Parganas, West Bengal, India.

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ABSTRACT:

Aims: The present study was aimed to find out percentage of arsenic affected population of three villages of Gaighata, North 24 Parganas, West Bengal, a severe Arsenicosis affected area and to compare different anthropometric indicators (especially health and nutritional anthropometry) of Arsenicosis affected population with non-affected groups. **Methods:** The study participants consisted of randomly selected 87 Male and 90 Female aged between 18 and 60 years belonging to the Arsenicosis affected families in Gaighata block of North 24 Parganas, West Bengal, India. All Anthropometric measurements were obtained by using standard Anthropometric techniques and Blood Pressure had also been taken to reveal out the consequences of health & nutritional status among Arsenicosis affected people after comparing non affected counterpart. **Results:** It is observed that male are more affected in Arsenicosis than female and the maximum Arsenicosis affected peoples are found between the age of 43 to 57 years. Weight, Body Mass Index, Mid Upper Arm Circumference, Percentage Body Fat, Fat Mass all represents the nutritional status are significantly lower among affected groups except the Fat Free Mass. Arsenicosis also results the hypertension or high blood pressure in affected people. **Conclusion:** Arsenicosis as a public health problem is a comparatively recent concept, for which effective treatment measures are still not known. The primary ways of prevention are the raising the level of awareness, Identification of the unsafe water sources, methods of removal of arsenic from the arsenic-contaminated water, and development of alternative sources of arsenic-free water.

KEYWORDS: Anthropometry, BMI, MUAC, Body Fat, Blood Pressure, Arsenicosis, Gaighata, North 24 Parganas.

INTRODUCTION:

Arsenic contamination in ground water and related health hazards are serious concerns in many countries of the world. Arsenicosis is a global problem but recent data reveals that

Asian countries, India and Bangladesh in particular, are the worst sufferers. In India, the state of West Bengal bears the major brunt of the problem, with almost 12 districts presently in the grip of this deadly disease (Ghosh *et.al.* 2008).

Arsenicosis is the effect of Arsenic poisoning, usually over a long period such as 5 to 20 years. Drinking arsenic-rich water over a long period results in various health effects. The limit of Arsenic in drinking water standard as per BIS (Bureau of Indian Standards) is 0.01mg/L. However affected West Bengal State is following the earlier standard as per BIS (1993) of maximum permissible value 0.05 mg/L (for detection) and 0.01mg/L (for removal). The lethal dose of Arsenic ranges from 120 to 200 mg in adults and is 2 mg/kg in children. Intake of drinking water having arsenic concentration beyond the permissible limit of 0.05 mg/ lit has deleterious effects on human health viz., cardiovascular problem, gastrointestinal, hematological effects, hepatic effects, renal effects, neurological effects, dermal effects, carcinogenic effects etc. (Elangovan and Chalach 2006) Inter-individual variation in arsenic methylation profiles is commonly observed in exposed populations. The underrepresentation of the upper BMI distribution was commonly observed in some studies. (Gomez-Rubio *et al.*, 2011) The associations of percentage arsenic species biomarkers with body mass index, percentage body fat, fat free mass, and waist circumference categories in unadjusted regression models and in models including all measures of body composition. (Gribble *et al.*, 2013)

MATERIAL AND METHODS:

The study sample consisted of randomly selected 87 Male and 90 Female aged between 18 and 60 years belonging to the arsenicosis affected families in Gaighata block of North 24 parganas, West Bengal, India. Excessive intake of arsenic in human body causes health hazards and is manifested in the form of arsenic poisoning. The arsenicosis individuals were diagnosed by medical team. Intake of drinking water having arsenic concentration beyond the permissible limit of 0.05 mg/ lit has deleterious effects on human health viz., cardiovascular (heart failure) problem, gastrointestinal (burning lips, painful swallowing, thirst, nausea, and severe abdominal colic), hematological effects (anemia and leucopenia), hepatic effects, renal effects, neurological effects (headache, lethargy, mental confusion, hallucination, seizures and coma), dermal effects (skin disorder, hyperkeratosis), carcinogenic effects (lung cancer) etc.

This study mainly intends to evaluate the health & nutritional status by using anthropometric and blood pressure measurement of the studied participants. Those families have been regarded in this investigation that member's are suffering from arsenic poisoning. Thus the consequences of nutritional status between Arsenicosis patient and non arsenicosis patient were revealed out while, the dietary intakes are same. Verbal consents were obtained from all subjects prior to the commencement of the study. Ages, sex, sources of drinking water, such kind of information were obtained by means of a questionnaire. There was no missing data.

Anthropometric Measurements:

All Anthropometric measurements were conducted by 1st and 2nd author using standard Anthropometric techniques (Mukherjee *et.al.*,2009). Anthropometric variables include Height, Weight, Mid Upper Arm Circumference (MUAC), Triceps (TSF) and Biceps (BSF) skin fold measurement. Weight and Height were measured to the nearest 0.5 kg and 0.1 cm respectively using Weighing machine and Martin's Anthropometer. Both for the Height and Weight, subjects were asked to remove their foot wear prior to take measurement. Skin folds were measured on the left side using a Holtan Skin fold Caliper.

Body Mass Index (BMI): Body mass index is a measure of body fat based on height and weight that applies to adult Male and Female. It was measured by using following formula.

$$\text{BMI} = \text{Weight (in K.G.)} / \text{Height}^2 \text{ (in meter)}$$

Percentage Body Fat (PBF): The percentage body fat was computed from biceps (BSF) and Triceps (TSF) skin folds following equation of Durnin and Womersley (Durnin, and Womersley 1974). The equation has been show to be valid for use among Indians. The following equations were used-

$$\text{PBF} = (4.95 / \text{DENSITY} - 4.5) \times 100$$

$$\text{Where density for Male is } = 1.1356 - 0.070 \times \log (\text{BSF} + \text{TSF})$$

$$\text{For Female } = 1.1362 - 0.074 \times \log (\text{BSF} + \text{TSF})$$

The high percentage body fat was set as >25 % in Male and >30% in Female as recommended by several researchers.

Fat Mass (FM) and Fat Free Mass (FFM) were computed following the standard equations:

$$\text{FM (Kg.)} = (\text{percentage body fat} / 100) \times \text{Weight (kg)}$$

$$\text{FFM (Kg.)} = \text{Body Weight (Kg)} - \text{Fat mass (kg.)} \quad (\text{Das and Bose 2006.})$$

Blood Pressure: Left arm systolic (SBP) and diastolic (DBP) blood pressure measured twice by using Aneroid sphygmomanometer and stethoscope and was averaged for analysis. Prior to the measurements, subjects were instructed to seat in a chair and the left arm was placed on the table at the level of the heart. A five minutes relaxation period before and between measurements was maintained throughout the study. (Nag and Ghosh 2016)

Statistical Analysis: All variables were checked for normality and it was found that majority of their distributions were not significantly skewed. Statistical analyses were undertaken using t-test and Chi-square test. Technical errors of measurements (TEM) were found to be within acceptable values. The difference of age has been regressed out while analyzing data. Sex difference had been evaluated only in body composition profile. Statistical significance was set at $p < 0.05$.

RESULTS AND DISCUSSION

The percentages of Arsenicosis affected people by sex are presented in Table 1 and fig 1. It is observed that the percentage of Arsenicosis affected people is 12.49% more in male than female. Age group wise distribution of Arsenicosis affected people are presented in Table 2 and fig 2. The affected people of Arsenicosis had been found from the age of 26 years both in male and female. But the highest frequency had been found in between the age of 43 and 57 years. Sources of drinking water of the people in the studied area are presented in Table 3. There is a significant ($*p < 0.05$) association of Arsenicosis and drinking deep tube well's water. Nobody has been found to drink water from shallow tube well (30-100ft) at present, though the affected peoples told that once they used to drink the water of shallow tube well's water. Descriptive statistics (Mean and SD) of anthropometry and blood pressure are presented in Table 4. It is found that the mean Weight ($p < 0.05$), BSF ($p < 0.001$), TSF ($p < 0.001$), MUAC ($p < 0.001$), BMI ($p < 0.005$), SBP ($p < 0.05$), DBP (0.01) are significantly higher in non arsenicosis people than the Arsenicosis affected people. The means and standard deviations of body composition variables are presented in Table 5. The mean of PBF (Male- $p < 0.05$ and Female- $p < 0.01$) and FM (Male- $p < 0.05$ and Female- $p < 0.05$) are significantly high among non arsenicosis people. In all cases age and sex difference has been regress out due to small sample size.

Conclusion: It is observed that males are more affected in Arsenicosis. The reason of this unlike exposure may be occurred due to the Male having Arsenicosis had born and brought up drinking the local tube well's water for many years. Whereas, the Female (mostly wives) had came there after getting married. So they got less chance to imbibe the arsenic contaminated water. The affected people of Arsenicosis have been found from the age of 26 years and the highest frequency has been found in between the age of 43 and 57 years in both male and female. It indicates that the people drink water for minimum 20 years to get affected from Arsenicosis and this affect will gradually increase while a person continued to drink arsenic contaminated water. People of this area either drink the deep tube well's (500-1000ft) water or the mineral water. It has been found that the more Arsenicosis affected people used to drink deep tube well's water. So the susceptibility of Arsenicosis is higher in drinking deep tube-well's water. Nobody has been found to drink water from shallow tube well (30-100ft) at present, though the affected peoples told that once they used to drink the water of shallow tube well's water. The evidence of nutritional status has been discussed with possible interpretation of the facts. After analyzing the data, it is observed that the people having Arsenicosis are nutritionally retarded. Body Mass Index, Mid Upper Arm Circumference, Percentage Body Fat, Fat Mass all represents the nutritional status are eventually low except the Fat Free Mass. While it is not disregarded the possibility that a nutritional effect could partially be responsible for the association between arsenic methylation, this effect could be also driven by other factors or other mechanism of our body (Gomez-Rubio *et al.*, 2011). The Arsenicosis also results the hypertension or high blood pressure in affected people. The potential association between Arsenicosis and high blood pressure is supported by experimental studies. *In vitro* work has shown that arsenic promotes inflammatory activity, oxidative stress and endothelial dysfunction through several mechanisms (Jiang *et al.*, 2011).

Arsenicosis as a public health problem is a comparatively recent concept, for which effective treatment measures are still not known. The primary ways of prevention are the raising the level of awareness, identification of the unsafe water sources, methods of removal of arsenic from the arsenic-contaminated water, and development of alternative sources of arsenic-free water (Ghosh *et al.*, 2008).

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Table 1: Distribution of Arsenicosis affected people by sex

Category	Arsenicosis affected People No (%)	Non Arsenicosis people No (%)
Male (N= 87)	36 (41.37)	51 (58.63)
Female (N= 90)	26 (28.88)	64 (71.12)
Total (N= 177)	62 (35.12)	115 (64.88)

Table 2: Age group wise distribution of Arsenicosis affected people

Age groups (in years)	Male N (%)	Female N (%)	Combined N(%)	Total no. of people in each age group
18-22	0 (0)	0 (0)	00 (0)	19
23-27	3 (16.6)	1 (5.5)	04 (22.1)	18
28-32	1 (7.1)	3 (21.4)	04 (28.5)	14
33-37	2 (11.1)	1 (5.5)	03 (16.6)	18
38-42	3 (13.6)	4 (18.2)	07 (31.8)	22
43-47	6 (23.1)	5 (19.2)	11 (42.3)	26
48-52	7 (29.1)	6 (25)	13 (54.1)	24
53-57	9 (39.1)	4 (17.3)	13 (56.5)	23
58-60	5 (38.5)	2 (15.3)	7 (53.8)	13
Total	36 (20.32)	26 (14.68)	62(35.02)	177

Table 3: Sources of Drinking water of the people in the studied area

Sources of Drinking water	Arsenicosis affected No. (%)	Non arsenicosis people (%)	Total
Deep Tube well (500-1000ft)	50 (42.01)	69 (57.99)	119
Mineral water	12 (20.69)	46 (79.31)	58
Colum Total	62 (35.12)	115 (64.88)	177

$\chi^2=6.88^{**}$, $p>0.001$

Table 4: Descriptive statistics of Anthropometry and blood pressure measures of Arsenicosis affected people and Non arsenicosis people.

Variables	Arsenicosis affected people (N=62)		Non Arsenicosis people (N=115)	
	Mean	SD	Mean	SD
Height (in cm)	154.57	18.225	153.82	19.65
Weight (in kg)*	50.072	12.8108	53.784	11.132
BSF (in mm)****	5.467	2.062	7.264	3.464
TSF (in mm)****	10.203	7.803	13.956	5.556
MUAC (in cm)****	23.746	2.402	25.2914	2.7348
BMI (kg/m²)***	20.956	3.157	22.729	3.6304
SBP (mm/hg)*	122.838	11.775	118.478	14.3298
DBP (mm/hg)**	81.90	8.874	78	9.0870

BMI – body mass index, BSF–biceps skin fold, TSF–triceps skin fold, MUAC – mid upper arm circumference, SBP- systolic blood pressure, DBP- diastolic blood pressure. Age and Sex difference has been regressed out. * $p<0.05$, ** $p<0.01$, *** $p<0.005$, **** $p<0.001$.

Table 5: The body composition of Arsenicosis affected people and Non arsenicosis people

Variables	Sex	Arsenicosis affected people			Non Arsenicosis people		
		N	MEAN	SD	N	MEAN	SD
PBF (%)	MALE *	36	17.304	4.231	51	19.628	5.056
	FEMALE **	26	25.149	3.980	64	28.084	4.902
FM (in Kg)	MALE *	36	9.364	3.309	51	11.311	4.175
	FEMALE *	26	12.038	3.557	64	14.705	4.880
FFM (in Kg)	MALE	36	43.524	7.042	51	44.992	5.123
	FEMALE	26	35.219	5.640	64	36.560	6.031

N, Means and Standard Deviations are presented in above table. PBF-percentage body fat, FM- fat mass, FFM- fat free mass. Age difference has been regress out. * $p<0.05$, ** $p<0.01$,

Figure: 1- The percentages of Arsenicosis affected people by sex

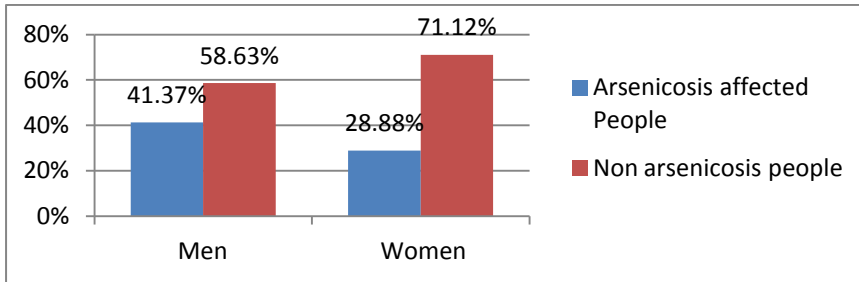


Figure-2: Age group wise distribution of Arsenicosis affected people

