

Evaluation of FVC, FEV₁, FEV₁/FVC % in Patients with Chronic Arsenicosis

Habiba T¹, Begum T², Begum S³, Ferdousi S⁴, Ali T⁵

Background: Arsenic toxicity from ground water contamination is highly focused public health problem in Bangladesh. Consumption of arsenic contaminated water may be associated with respiratory symptoms and can decrease lung functions along with skin lesion. Proper investigation of this problem is crucial to prevent respiratory complications in these arsenic vulnerable populations. **Objectives:** FVC, FEV₁, FEV₁/FVC % were studied in chronic arsenicosis patients with skin lesion from arsenic exposed area to observe their lung function status. In addition, correlations of these lung function parameters with arsenic concentration in drinking water and duration of consumption were also studied in this group of population. **Study design:** For this, total 80 subjects age ranged from 20-50 years of both sexes were included. Among them 40 were patients of chronic arsenicosis with skin lesion and were taken in study group and age and sex matched 40 apparently healthy subjects residing in the same arsenic contaminated area but without skin lesion, were designated as control group. **Methods:** This study was carried out in the department of Physiology, BSMMU from July 2005 to June 2006. FVC, FEV₁ and FEV₁/FVC % were measured by Digital Spirometer. Arsenic level of the tubewell water was determined by Hybrid Generation Atomic Absorbance Spectrophotometer. Data were analyzed statistically by Chi-square test, Student's unpaired "t" test and Pearson's correlation coefficient test as applicable. **Results:** The mean percentage of predicted values of FVC, FEV₁ in exposed non-arsenicosis subjects were within normal ranges. Again they were significantly lower in chronic arsenicosis patients. There was no significant difference in FEV₁/FVC% between the two groups. FVC and FEV₁ were negatively correlated with arsenic concentration in tube well water in both groups. But FEV₁/FVC% was negatively correlated in exposed nonarsenicosis subjects and positively correlated in arsenicosis patients. Again, with duration of consumption of arsenic contaminated tube well water, FVC was positively and FEV₁/FVC% was negatively correlated in both exposed non arsenicosis and chronic arsenicosis patients. But FEV₁ was negatively correlated in non arsenicosis and positively correlated in chronic arsenicosis patients. But all the relationships were not statistically significant. **Conclusion:** Therefore, the result of the present study reveals that arsenicosis patients are suffering from respiratory insufficiency. In addition, populations consuming higher arsenic concentration in drinking water are at the risk of lung function impairment and ultimately may lead to respiratory disorder.

Key words: FVC, FEV₁, Arsenicosis.

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Introduction:

Arsenic is a natural element. Arsenic toxicity from ground water contamination is an emerging public

health problem in Bangladesh. In total, 70 million people in Bangladesh are thought to be potentially at risk of consuming arsenic

contaminated water.¹⁻² Arsenic affects almost all the organs including skin, liver and also all systems including respiratory system.² It has been reported that, the consumption of arsenic contaminated water may be associated with respiratory symptoms and can decrease lung functions along with skin lesion.³⁻⁵ There is evidence that exposure to arsenic causes significant impairment of respiratory function.⁶⁻⁸ In addition some investigators reported that, respiratory diseases associated with chronic arsenicosis are predominantly of obstructive variety, though restrictive and malignant changes can also occur.⁹⁻¹⁰ Various factors affect arsenic toxicity. It has been suggested that physical and chemical form, route of entry, duration of exposure and amount of arsenic in tube well water are among these factors.¹¹⁻¹³ Again, high arsenic level in drinking water causes an increase in mortality among 30 to 39 year's individuals who commonly form chronic obstructive pulmonary diseases.¹⁴⁻¹⁵ The reduced values of almost all spirometric parameters of lung function are due to poor ventilatory efforts in patients with chronic arsenicosis.¹⁶⁻¹⁸

In the context of Bangladesh chronic arsenicosis is a major health problem and 60 districts have arsenic contaminated ground water of various degree. The southern part covers most of the contaminated area.¹⁹⁻²⁰ A large number of people in these areas have chronic arsenicosis and their impaired lung function may remain unnoticed for long time. Unfortunately, most of them are treated without knowing the underlying cause. In Bangladesh, there is lack of adequate information regarding lung function status in patients with chronic arsenicosis.

Though, some study had been done in abroad such as in Chile, West Bengal of India, but no published data regarding Spirometric lung function parameters in arsenicosis are available in Bangladesh.

Therefore, the present study was undertaken to evaluate ventilatory function of lung, in patients with chronic arsenicosis.

Methods:

This cross sectional study was carried out in the Department of Physiology from July 2005 to June 2006 in BSMMU, Dhaka.

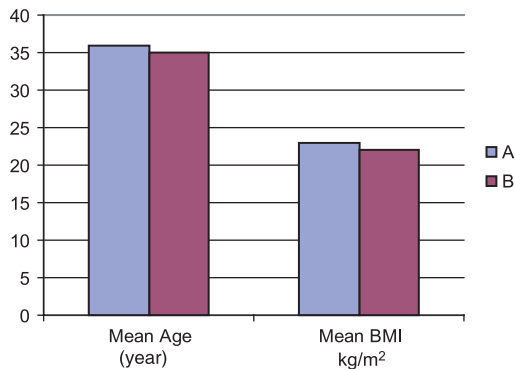
Among 80 subjects, 40 patients of chronic arsenicosis with skin lesion were taken in study group (group-B) and 40 subjects residing in the same arsenic contaminated area but without skin lesion, were taken as control (Group-A). All the subjects had age range from 20-50 years & were of both sexes. They were selected from the "Arsenic clinic" in Upozila Health Complex, Daudkandi Sadar & Illiotgong health sub center, situated in the Southern part of Bangladesh and the area where tubewell water is highly contaminated with arsenic. Subjects with history of smoking, asthma, environmental or occupational lung diseases, pulmonary tuberculosis & cardiovascular diseases were excluded from the study. Before examination, the aim and objectives and benefit of the study were explained to all subjects and they were encouraged for voluntary participation. Informed written consent was taken. Detail personal history, medical history, family history were taken. Thorough clinical examinations of each subject was done and height, weights were measured and BMI was calculated. All these information were recorded in a prefixed questionnaire.

For assessing lung function, FVC, FEV₁, FEV₁/FVC% ratio were measured by Digital Spirometer described by Clement Clarke International in a room of the arsenic clinic at normal room temperature and humidity. Water arsenic level was determined by Hybrid Generation Atomic Absorbance Spectrophotometer in the laboratory of the Department of occupational and environmental health of NIPSOM.

Data were loaded in SPSS Windows version-12. Statistical analysis of the data were done by unpaired Student's t test, Pearson's Chi-square test, Pearson's correlation coefficient test wherever applicable.

Results:

The demographic variables of the study subjects are presented in Figure 1.



Group A: Exposed non arsenicosis (control)

Group B: Exposed arsenicosis patients (study)

Figure 1: Mean age and BMI in different groups

Mean (\pm SD) age and BMI of study subjects were similar between the two groups and no statistical significant differences were observed. Both groups had similar proportion of male and female subjects.

The results of FVC, FEV₁, FEV₁/FVC% are shown in Table-I.

Table- I

Mean \pm SD Percentage of predicted values of FVC, FEV₁, FEV₁/FVC % in two groups (n=80)

Parameters	Group A	Group B	P value
FVC (L)	91.8 \pm 25	80.5 \pm 27	0.000***
FEV ₁ (L)	88.3 \pm 24	76.63 \pm 26	0.000***
FEV ₁ /FVC(%)	110.60 \pm 8	109 \pm 8	0.669 ^{ns}

Group A : Exposed non-arsenicosis (control)

Group B: Exposed arsenicosis patients (study)

*** = Significant at p<0.001

n = Number of subjects

The mean of percentage of predicted value FVC and FEV₁ was significantly lower (P<0.001) in group B than those of group A.

Again the mean of percentage of predicted value of FEV₁/FVC% was lower in group B in comparison to that of group A, but difference was statistically non significant.

The concentration of arsenic in tube well water of the arsenic contaminated area and duration of consumption of the subjects were presented in Table - II.

Table-II

Mean \pm SD Arsenic concentration in tubewell water and its duration of consumption (n=80)

Groups	n	Water arsenic concentration (ppb)	Duration of consumption (years)
A	40	147 \pm 33.06 (97-176)	25 \pm 10.07 (10 - 45)
B	40		26 \pm 9.34 (10 - 50)

Statistical analysis

Groups	p value
A vs B	1.000 ^{ns} 0.671 ^{ns}

Group A: Exposed non-arsenicosis (control)

Group B: Exposed arsenicosis patients (study)

Figure in parenthesis indicates range

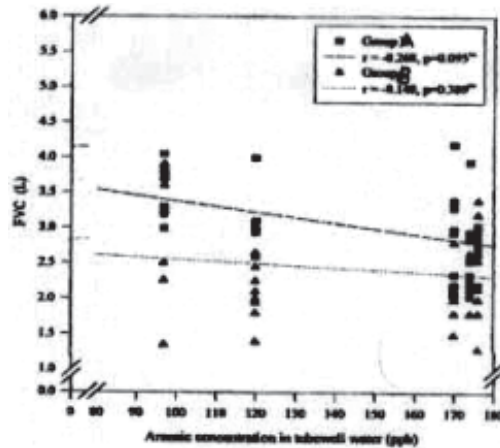
ns = Not significant

n = Number of subjects

The relationships of FVC, FEV₁, FEV₁/FVC% with arsenic concentration in water, and its duration of consumption were observed. Results are shown in Figure 2, 3, 4, 5, 6, 7.

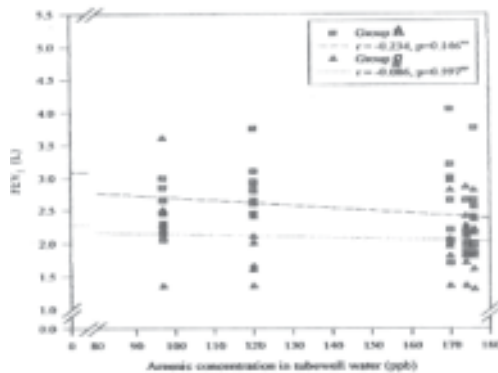
FVC, FEV₁ showed negative correlation with arsenic concentration in tubewell water in both groups. But FEV₁/FVC% showed negative correlation in group A and positive correlation

in group B. Again FVC showed positive and FEV₁/FVC % showed negative correlation in both groups whereas FEV₁ showed negative correlation in group A and positive correlation in group B with duration of consumption of arsenic contaminated water. But all these relationships were not statistically significant.



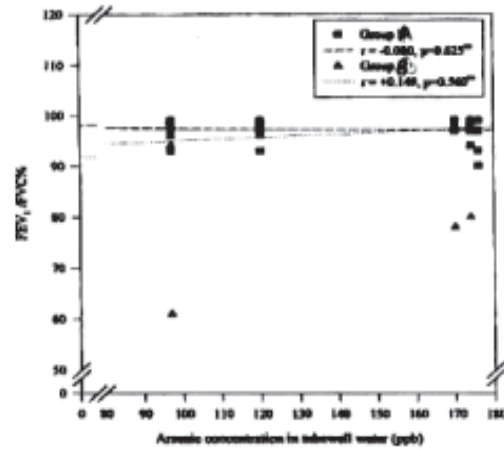
Group A: Exposed non arsenicosis (control)
Group B: Exposed arsenicosis patients (study)

Figure 2: Relationship of FVC with arsenic concentration in tubewell water (n= 80)



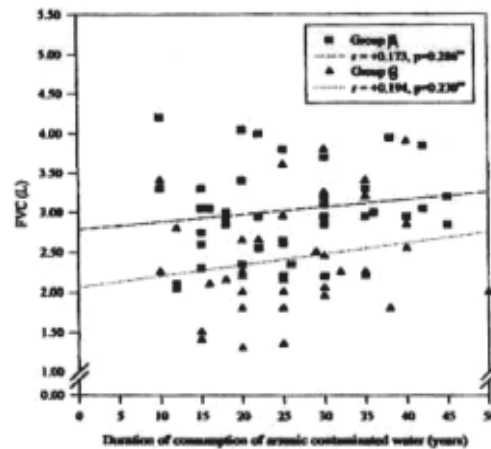
Group A: Exposed non arsenicosis (control)
Group B: Exposed arsenicosis patients (study)

Figure 3: Relationship of FEV₁ with arsenic concentration in tubewell water (n = 80)



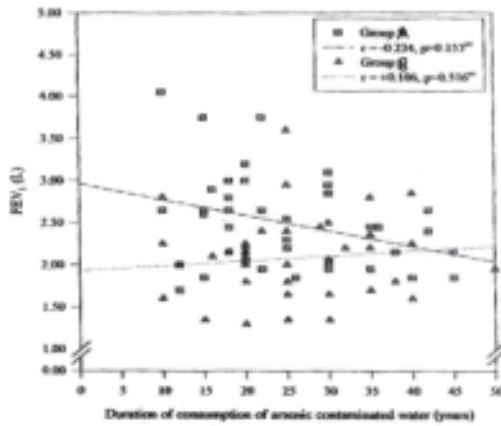
Group A: Exposed non arsenicosis (control)
Group B: Exposed arsenicosis patients (study)

Figure 4: Relationship of FEV₁/FVC % with arsenic concentration in tubewell water (n = 80)



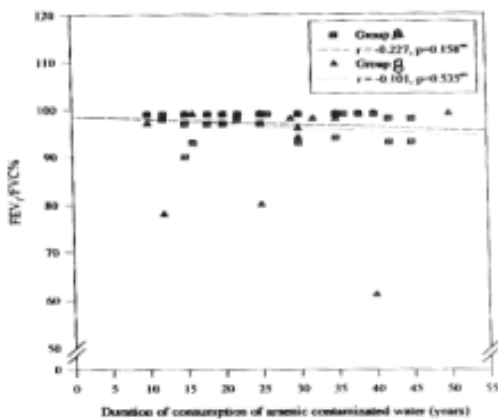
Group A: Exposed non arsenicosis (control)
Group B: Exposed arsenicosis patients (study)

Figure 5: Relationship of FVC with duration consumption of arsenic contaminated tubewell water (n = 80)



Group A: Exposed non arsenicosis (control)
Group B: Exposed arsenicosis patients (study)

Figure 6: Relationship of FEV₁ with duration consumption arsenic contaminated tubewell water (n = 80)



Group A: Exposed non arsenicosis (control)
Group B: Exposed arsenicosis patients (study)

Figure 7: Relationship of FEV₁/FVC % with duration consumption arsenic contaminated tubewell water (n = 80)

Discussion:

In the present study, percentage of predicted value of FVC, FEV₁ and FEV₁/FVC% were observed in patients with chronic arsenicosis and in apparently subjects without arsenicosis in arsenic exposed area. Again, correlation of these

parameters with arsenic concentration in tubewell water and its duration of consumption were observed. All the subjects of two groups were matched for age, sex and BMI.

In the present study, mean percentage of predicted values of FVC and FEV₁ were within normal ranges i.e. > 80% of the predicted values except FEV₁ in patients with chronic arsenicosis which was below the lower limit of normal range. Again, these findings are consistent with findings of some investigators of different countries.^{9,21-22} Lower FEV₁/FVC% observed in patients with arsenicosis was statistically non significant and can not be compared due to lack of available data.

The data of our study showed that arsenic concentration in the tubewell water consumed by both the arsenic exposed groups was higher than the national standard (0.05mg/l)²³⁻²⁴. Therefore, the subjects of both groups were drinking arsenic contaminated tubewell water and their mean duration of consumption was almost similar. However, a significant ($p < 0.001$) number of subjects were taking arsenic contaminated tubewell water for more than 10 years in arsenic exposed groups.

In the present study, the correlations of spirometric parameters with concentration of arsenic in tubewell water and duration of consumption were not statically significant. FVC, FEV₁, showed negative correlations in both groups but FEV₁ / FVC % was negatively correlated in non arsenicosis and positively correlated in chronic arsenicosis patients. De et al. also reported similar non significant negative correlation for all parameters but significant only in FEV₁.¹⁰ Furthermore, with duration of consumption of arsenic contaminated water, FEV₁ / FVC % showed negative and FVC showed positive correlation in both the groups whereas FEV₁ showed negative in non arsenicosis and positive in chronic arsenicosis. No similar observations were available for comparison.

The comparative reduced values of these spirometric parameters and FEV₁ below normal limit in patients with chronic arsenicosis indicate their poor ventilatory efforts.

Lantz et al. suggested decreased resistance to infections due to suppressed or enhanced effect of pulmonary alveolar macrophages (PAM) activity might be related to arsenic exposure.¹⁵⁻¹⁶ Increased production of mediators of inflammation and subsequent inflammatory changes in lung parenchyma might be linked to increased activation of PAM.¹⁰ Both these factors may ultimately produce fibrotic changes in lung parenchyma leading to decreased expansibility in lung tissue in chronic arsenicosis. Moreover, arsenic accumulates in airways and lung parenchyma. This accumulation of arsenic may decrease the expansibility of the lungs, which ultimately leads to impaired respiratory function.^{17, 18, 25}

Conclusion:

However, from the above findings it can be concluded that arsenicosis patients are suffering from poor pulmonary ventilation. In addition, populations consuming higher arsenic concentration in drinking water are at the risk of lung function impairment and ultimately may lead to respiratory disorder.

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