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LUNG FUNCTION PARAMETERS OF BANGLADESHI PEOPLE IN DIFFERENT LIVING CONDITIONS

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Abstract

The "standard" values of pulmonary function tests obtained from Western populations do not agree with that of people of Bangladesh. The present study was conducted with a view to determine the values of lung function parameters such as vital capacity, forced vital capacity and forced expiratory volume in one second for healthy Bangladeshi population from two different income group with different living conditions. 300 non-smokers of age group 20-40 years were selected for the study of which 150 were university students and employees and 150 were slum dwellers of low income group. In addition, 150 female subjects were also included in the study in order to compare the lung function parameters with those of male subjects. The lung function values correlated positively with height and weight, and negatively with age. There is a definite effect of aging on lung function showing a declining trend from age 35 years onwards. The slum dwellers showed lower values of lung functions than the other group. The difference decreased with age. Prediction equations were set up using height, weight and age as parameters. The lung capacity of the female population was found to be lower than that of the male population. In general the lung function values were found to be 80% of the European Standards.

Keywords: Vital Capacity, Forced Vital Capacity, Forced Expiratory Volume in one second.

1. Introduction

Pulmonary function tests provide a readily available objective assessment for the physiology of the lungs. They facilitate the diagnosis and therapy of the pulmonary diseases. For evaluation of these tests standard values are necessary. In routine testing, lung function of community members is measured and then compared with predicted values based on sex, age, height etc. which has been derived from a population considered to be normal. However, the subjects examined may have different racial and ethnic origins from those of the standard group. Workers measuring and analyzing lung function of the Hispanic population in the USA, have found a definite difference between their observed values and predication equations and existing normal ones derived for white population of European and North American origin.

The physiology of lungs can be assessed by testing function parameters like vital capacity (VC), forced vital capacity (FVC) and forced expiratory volume in one second (FEV_1). These parameters are reported [1] to be related to different anthropometric measurements like body height (HT), body weight (WT), chest size, sitting height etc.

In order to establish the relationship between the disease conditions and different lung function parameters it is essential to have reference values for lung function parameters for the European and American populations are available [1] [2], such data are not available for Bangladeshi population. It has been reported that VC, FVC and FEV_1 may vary depending on age, sex, race and other anthropometric parameters [3]. As such it is essential to establish normal values of such parameters to make proper diagnosis of lung disorders.

A study 300 samples of healthy non-smoking Bangladeshi population was undertaken to set up standard values and predication equations of VC, FVC and FEV_1. Similar analysis was conducted with 150 young healthy female subjects of age group 20-30 for VC, FVC and FEV_1 in an attempt to establish reference values for Bangladeshi females. Such a study finding will help to increase diagnostic obstructive airway disease in Bangladesh.

There exist some reference values of Relative lung function test and other lung function parameters for developed country population [6]. However; similar references appropriate for countries like ours has not yet been fully developed [4].

2. Materials and methods

Data were obtained form 300 healthy (not suffering from any detectable disease) non-smoker male subjects form different types of environment of age varying form 20 to 40 years. Among them 150 were university students and employees who had hailed form reasonably good living conditions (group –A) and 150 were slum dwellers with various low paid jobs like rickshaw-puller, hawkers etc., who lived in unfavourable environment (group –B). Personal data such as age, sec, height, weight build chest expansion together with information on social environment income range etc., were recorded. The weight, height etc, were measured with the subjects wearing indoor clothing but without shoes. Similar analysis with 150 young healthy female subjects of age group 20-30 for VC, FVC and FEV_1 were obtained.

A vitalograph Wedge Bellows Spirometer (Vitalograph limited, UK) was used for measurement of the different lung functions [8]. Spirometry is a useful technique for assessing lung functions in terms of inhalation and exhalation of air [4], [5]. In medical field this is used in diagnosis and prognosis of several conditions and diseases. All spirometric measurements were performed with the subjects seated and wearing nose clips. These were repeated when necessary. The ambient pressure and temperature were recorded from a Fortin's barometer and its attached thermometer. The initial readings of VC, FVC and FEV_1 were corrected from ATPS (Atmospheric Temperature and Pressure Saturated) to BTPS (Body Temperature and Pressure Saturated)

Scatter diagrams were drawn to see if there is any marked correlation between VC, FVC and FEV_1 and the following parameters, namely, age, height, weight, trunk length (TL) and chest expansion (CE). Prediction equations were then set up using multiple regression methods. Bivariate Tables for VC, FVC and FEV_1, were made for both groups of subjects with the variables and class intervals.

In present study lung functions of 300 adult males and 150 females of different socio-economic status have been reported in an attempt to establish standard values and predication equations of VC, FVC and FEV_1 as reference values for Bangladeshi population.

3. Results

In group A the lower age groups (20-21) years predominated with very few cases in the highest age group. In group B the age distribution was more uniform except in the highest age group where numbers were smaller.

The average values of the three parameters VC, FVC and FEV_1, for age groups are shown in Fig-1, 2 & 3. In both socio-economic groups, the lung function parameters showed positive correlation with height and weight and a negative (albeit insignificant) correlation with age (Tables I and II). Correlation of VC, FVC and FEV_1 with these parameters was stronger in the university students and employees than in the slum dwellers. All the lung function variables correlated significantly with height both in university students and employees ($p<0.01$) and in the slum dwellers ($p<0.05$). Body weight correlated significantly with VC and FVC in the university students and employees ($p<0.05$). The correlation between body weight and FEV_1 in this group as well as those between body weight and VC, FEC and FEV_1 in the slum dwellers were insignificant. Correlations with other parameters, e.g., age trunk length and chest expansion was insignificant.

The following prediction equations were worked out of VC, FVC and FEV_1 in Bangladesh male subjects

For University students and employees

	Standard error
$VC = 4.98 \times \text{height} - (2.38\text{x}10^{-2}) \times \text{age} - 4.02$	(±0.37)
$FVC = 3.03 \times \text{height} - (2.95\text{x}10^{-2}) \times \text{age} - 0.63$	(±0.22)
$FEV_1 = 4.41 \times \text{height} - (1.98\text{x}10^{-2}) \times \text{age} - 3.73$	(±0.39)

For slum dwellers:

$VC = 4.87 \times \text{height} - (3.34\text{x}10^{-2}) \times \text{age} - 3.72$	(±0.38)
$FVC = 5.47 \times \text{height} - (3.36\text{x}10^{-2}) \times \text{age} - 4.69$	(±0.43)
$FEV_1 = 4.22 \times \text{height} - (4.08\text{x}10^{-2}) \times \text{age} - 3.08$	(±0.32)

Table-I: Correlation coefficients of University students and employees (male, 150 cases).

Parameters between which correlation coefficient is determined	Age	HT	WT	TL	CE
VC	-0.30	0.63	0.40	0.43	0.31
FVC	-0.29	0.62	0.40	0.42	0.31
FEV_1	-0.25	0.59	0.35	0.43	0.22

Table-II: Correlation coefficients of Slum Dwellers (male, 100 cases).

Parameters between which correlation coefficient is determined	Age	HT	WT	TL	CE
VC	-0.29	0.47	0.29	0.30	0.31
FVC	-0.30	0.45	0.28	0.29	0.30
FEV_1	-0.35	0.39	0.25	0.27	0.15

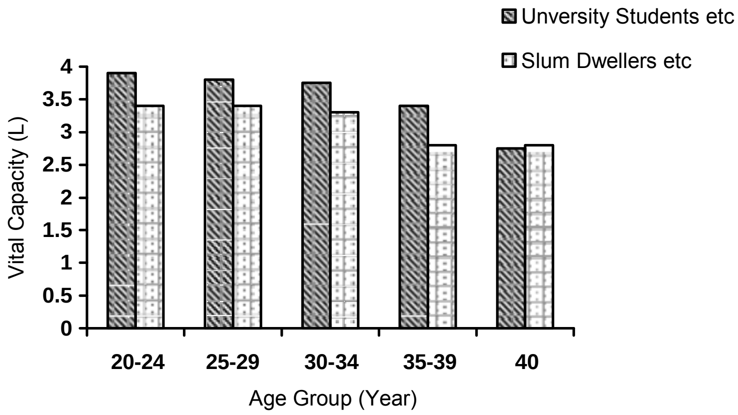

Figure 1: Age Group (Year) VS vital capacity (L)

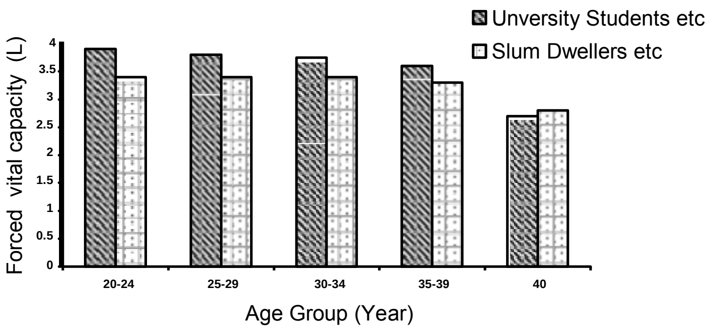

Figure 2: Age Group(Year) VS Forced vital capacity (L)

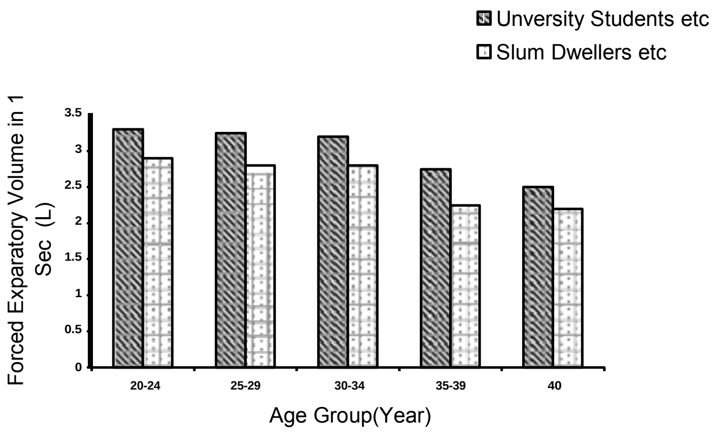

Figure 3: Age Group (Year) VS Forced Expiratory Volume in 1 Sec (L)

Mean values for VC, FVC and FEV_1 for 150 female subjects with different age groups are shown in Table 3. These lung function parameters were observed to have highest values i.e. 2.796±0.42, 2.745±0.41 and 2.506±0.43 litres for VC, FVC and FEV_1, respectively for age group 24-25 years. The lowest values for 2.305±0.15, 2.305±0.15and 1.930±0.29 litres for the respective parameters were observed for the age group 28-30 years (Table III). The correlation coefficients of various parameters i.e., height, weight, chest expansion, trunk length and VC, FVC, and F EV are shown in Table 4. Significant positive correlation was observed between lung functions and trunk length ($r \geq 0.5$), followed by that for height ($r \geq 0.3$). Insignificant correlation was found between chest expansion and lung function parameters ($r \leq 0.3$) while weight showed some degree of correlation with VC and FVC ($r \approx 0.3$) but not for FEV_1 ($r =0.2$). The average heights of the male subjects were higher compared to that of the females as expected. The values of VC, FVC and FEV_1 for the female subjects within 90, 95 and 99% confidence limit are shown in Table IV. The mean values for VC, FVC and FEV_1 are 2.64, 2.58 and 2.37 litres. These values are lower than those for the healthy male subjects whose average height were larger compared to that of the female subjects

Table III. Table for Average Value (150 Females)

Age group (year)	Mean vital Capacity (Litre)	Mean forced Vital Capacity (Litre)	Mean Expiratory Volume in one second (Litre)
20-21	2.616±0.38	2.452±0.41	2.251±0.40
22-23	2.533±0.36	2.521±0.34	2.301±0.38
24-25	2.796±0.42	2.746±0.41	2.506±0.43
26-27	2.671±0.31	2.612±0.34	2.461±0.33
28-30	2.305±0.15	2.305±0.15	1.930±0.29

Table IV. Table for Correlation Coefficients (150 Females)

Parameters	Vital Capacity (Litre)	Forced Vital Capacity (Litre)	Expiratory Volume in one second (Litre)
Height	0.3483	0.3878	0.3316
Weight	0.3077	0.2929	0.2102
Chest Expansion	0.1192	0.1618	0.1496
Trunk Length	0.4599	0.4510	0.5906

Table V. Table for Confidence Limit: (150 Females)

Parameter	Mean value	SD	90%	95%	99%
VC	2.64	± 0.077	2.52-2.77	2.49-2.79	2.44-2.84
FVC	2.58	±0.081	2.44-2.72	2.42-2.74	2.37-2.80
FEV_1	2.37	±0.087	2.23-2.51	2.20-2.54	2.15-2.60

4. Discussion

The difficulties of selection of appropriate reference population for prediction of lung function have been recognized for quite some time. It is recognized that lung function depends upon genetic and environmental influences. For this reason and since standard values and prediction equations for lung functions of Bangladesh population does not exist, it was decided to undertake a survey of healthy Bangladesh population in order to establish bivariate tables and prediction equation for use by the medical professionals. The present study is a survey and comparison of the lung functions of 300 healthy non-smoker Bangladeshi male subjects form two different income groups with different living conditions. There were 150 cases of university students and employees and 150 cases of slum dwellers.

In previous studies as in our one the lung capacity of Asian population was found to be about 20% lower value than the standard values setup for the Europeans. A review of 29 cases of healthy African adults showed considerable variations in standard parametric measurements [8]. The values varied from tribe to tribe and also depended on the altitude of their habitat for example sea level or mountain area. Women in all the surveys mentioned showed smaller mean values than men which with the finding reported here for Bangladeshi female population.

Schoenberg et al formed an equation on the assumption that respiratory function rises with age for the young (up to about 25 year) and then begins a slow decline [8]. Actual measurements seem to show a very slow decline up to 30 and a sharper decline after that. In another group of working class people (smoker, non-smoker and ex-smokers) the plateaus seemed to shift to a lower age and decline sets in earlier. The negative correlation with age observed in our study has confirmed results of previous worker

Our data showed positive correlation between lung function and height & weight and a negative correlation of lung function with age. The other parameters, taken for test purpose, namely trunk length and chest expansion were expected to have a relationship with lung capacity and this was found to be so although the correlation coefficients were smaller. These were not of height, ages in the equation were considered sufficient.

The values of all lung function parameters were slightly lower (by approximately 12.5% in young adults) in the slum dwellers than in the university students and employees. This is to be expected as there is a great difference in the living conditions, nutrition status etc, between the two groups. In the higher age groups the lung functions seemed to have approached closer. However the sample sizes in the higher age groups were not large. An increaser in the number of subjects might confirm or rule out our observation.

5. Conclusion

The present study of lung function of Bangladeshi non-smoker healthy male subjects from two different types of environments (university student/employees and slum dweller) showed that

(a) In general that lung capacity and volumes of our population are lower than those of European by about 20%. (b) Lung function values are lower (by approximately 12.5% in young adults) in the low income groups with unfavourable living conditions and probable malnutrition.
(c) The lung function correlates well with height in both socio-economic groups. Correlation with body weight is less remarkable. The lung function showed a steady decline with aging.
(d) The prediction equation and bivariate tables for healthy non-smoking Bangladeshi male population could be used by medical practitioners of expected values of lung function.
(e) In general lung capacity of the female population is lower than that of the male population reported earlier. There is a definite effect of ageing showing a decline in vital capacity values among age group 28-30 years and onwards.
(f) Female lung capacity is found to be lower than that of male population whose average height is large. The lung function parameters have to be studied with large sample size so as to set a reference value for female subjects.

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