PARAMETERS OF LUNG FUNCTION TESTS IN HEALTHY ADULT BANGLADESHI POPULATION RESIDING WITHIN DHAKA CITY

Rubyat Mostofa[1*], Qazi Shamima Akhter[2], Santunur Rahman[3]

ABSTRACT

Background: Lung functions are affected by age, gender, body built, ethnicity, environmental, socioeconomical, technical and other unidentified factors. Availability of appropriate reference value is necessary for interpretation of lung function tests and in assessment of respiratory disease. The standard value of pulmonary function test which is obtained from western population may not agree with Bangladeshi population as the two entirely different populations vary in ethnicity, body built, socioeconomic condition and environmental factors. Thus, attempt needs to be made to obtain values of these parameters more specific for the population of this region. **Aim**: The present study was carried out to find out values for lung function parameters of Forced Vital Capacity (FVC), Forced Expiratory Volume in 1st second (FEV1) and ratio of Forced Expiratory Volume in 1st second to Forced Vital Capacity (FEV1/FVC) of healthy adult Bangladeshi population residing in different parts of Dhaka city to contribute data towards obtaining reference value for these parameters for healthy Bangladeshi population in the near future. **Materials and Method:** A cross sectional study was conducted in the department of Physiology, Dhaka Medical College, Dhaka from July 2017 to June 2018. A total number of 150 male subjects and 150 female subjects were selected with age ranging from 18 to 45 years. The subjects were selected from different areas of Dhaka city on the basis of exclusion and inclusion criteria. The study parameters were estimated in the department of Physiology, Dhaka Medical College, Dhaka by computerized digital autospirometer. Data were collected in a predesigned structured questionnaire form by the researcher herself. For statistical analysis Unpaired Student's 't' test and Pearson's correlation coefficient (r) test were performed by using SPSS windows, version 16. p value <0.05 was accepted as level of significance. **Results:** In this study, values for lung function parameters of healthy adult Bangladeshi population residing within Dhaka city were estimated. Mean value for FVC, FEV1 and FEV1/FVC ratio were found 3L, 2.82 Land 93% in male subjects and 2.43L, 2.21L and 93% in female subjects respectively. **Conclusion**: In this study we observed the values for lung function parameters of FVC, FEV1 and FEV1/FVC ratio for adult healthy Bangladeshi population residing in Dhaka city and may be considered as a visionary contributing step towards determining the parameters' value for reference in this country. More such studies in other parts of Bangladesh needs to be carried out. Data from such studies may be compiled to eventually develop a reference value for the above parameters which would be more specific for healthy adult population of Bangladesh.

1*. Department of Physiology, Shahid Ziaur Rahman Medical College, Bogura, Bangladesh.
Email: rubyatmostofa@yahoo.com. [**Address of Correspondence**]

2. Department of Physiology, Dhaka Medical College, Dhaka. Bangladesh.

3. Sherpur Upazilla Health Complex, Bogura, Bangladesh.

INTRODUCTION

Lung function values are affected by age, gender, body built, ethnicity, environmental, socioeconomical, technical and other unidentified factors. So, there are no "normal values" for lung function tests, which can be applied to all individuals in a given population. Therefore, measured value of lung function tests should be compared with a reference value which is derived from similar age, gender and ethnicity. Application of reference values which is developed for other population may result in major errors of interpretation[1].

American Thoracic Society (ATS) recommends such reference values should be based on healthy people with the same anthropometric characteristics and ethnic origin[2]. For the American population, ATS recommends the use of the data which was derived from the Third National Health and Nutrition Examination survey (NHANES III 1988-1994). It concerns with the Caucasian, African-American and Mexican –American population [3].

In Europe, previously they used the data recommended by the European community for steel and coal reference[4]. Recently, European Respiratory society (ERS), conducted a study under the name of Global Lung Function Initiative (GLI) in 72 centers of 33 countries. Quanjer et al. conducted this studies and analyzed 16000 data to develop a reference value for Spirometric indices known as global lung function 2012 equation which are now applicable globally to different countries[5]. However, this study did not give any significant attention to South Asian countries.

Spirometry is the most common method of pulmonary function test. The basic lung function tests that measure the air that is expired and inspired are included in this method. Spirometry is an invaluable, non invasive procedure. It is easy to perform as it is portable and can be performed any where[6].

In Bangladesh few data are available from old studies. Choudhury et al. conducted a study on 250 male Bangladeshi subjects for lung function parameters[7]. They found the predicted values for Vital Capacity (VC), FVC and FEV1 are 20% lower than standard tables set up for Europeans.

The aim of this work was to find out values for lung function parameters of FVC, FEV1 and FEV1/FVC ratio of healthy adult Bangladeshi population residing in different parts of Dhaka city to contribute data towards obtaining reference value for these parameters for healthy Bangladeshi population in the near future.

MATERIALS AND METHOD

This cross sectional study was conducted in the department of Physiology, Dhaka Medical College, Dhaka from July 2017 to June 2018. Three hundred apparently healthy adult male and female, residing in Dhaka city were selected for the study based on inclusion and exclusion criteria.

Sampling technique

Dhaka city was divided into zones according to the socioeconomic condition of the population. About 10% of the population of Dhaka city belongs to upper social class, 50% from middle and 40% from low social class[8]. Upper social class population mainly resides in Banani, Baridhara, Basundhara residential area, Dhanmondi, Uttara and selected areas of Gulshan. Middle class population resides in Mohammadpur, Motijheel, Paltan, New Market, Shaymali, Khilgaon and Ramna[9]. The slums in Dhaka city are found in Adabor, Badda, Chakbazar, Jatrabari, Kamrangir chor and Mugda para where the people of low socioeconomic status lives[10]. In order to make the sample representative, 30 subjects were chosen from those upper class areas, 150 from middle class and 120 from low socioeconomic are as a sperinclusion and

exclusion criteria. The subjects were asked to respond to a standardized respiratory symptoms questionnaire, based on the ATS and the National Heart and Lung Institute (NHLI), Division of Lung Disease (DLD) questionnaire (ATS-DLD 78A questionnaire)[1,11].

Procedure for spirometry

Spirometry was performed using Minato Autospiro (AS-307/AS-507) which is proven to provide a high degree of accuracy and reliability. All study subjects were allowed to perform a minimum of 3 and a maximum of 8 tests and the best FVC, FEV1 and FEV1/FVC was selected and used for further analysis. The spirometer testing was performed following a standardized procedure adherent to ATS guideline under direct supervision of the principal investigator. ATS acceptability and reproducibility criteria was followed for selection of best pulmonary function curve.

Analysis was performed by using a computer based statistical program SPSS (Statistical Package for Social Science) version 16. Results were presented as mean and standard deviation (mean ±SD). Unpaired Student's "t" test was done to compare between groups. Pearson's correlation co-efficient (r) test was performed to explore the relationship between study parameters and independent factors.

RESULTS

Table 1 displays the sociodemographic characteristics of the participants (both male and female).Here the mean age for male was 25.99 ± 8.37 years and that of female was 26.31 ± 7.53 years. The Body Mass Index (BMI) was found to be within the normal range for both male and female. Table 2 shows the study parameters in both male and female. In case of male subjects all the parameters were significantly higher when compared to female ($p<0.001$).The current study showed that, mean value for FVC, FEV1 and FEV1/FVC ratio were 3L, 2.82L and 93% in male subjects and 2.43L, 2.21L and 93% in female subjects respectively. A positive correlation was observed between the study parameters (FVC,FEV1) and the height as well as weight of the study subjects and were statistically significant for both genders as can be observed in Table 3.

On comparing (appendix i) our results showed lower mean values for FVC and FEV1 than Caucasian, African, Indian and Pakistani population. The highest value for FVC and FEV1 was observed in Caucasian population. Our mean values were also less than African and Pakistani population, this may be due to less mean height. Our results were almost similar to Indian population this may be due to similar height, weight and same environmental exposure.

Table 1: General characteristics of the study subjects (N=300)

	Male (n=150)	Female (n=150)
Age(years)	25.99 ± 8.37	26.31 ± 7.53
Height(cm)	166.41 ± 6.33	156.05 ± 5.36
Weight (kg)	64.70 ± 10.08	58.07 ± 8.05
BMI(kg/m²)	23.31 ± 2.98	23.81 ± 2.98

Results were expressed as mean±SD N= total number of subjects
BMI=Body Mass Index

Table 2: Mean of study parameters of the subjects (N=300)

	Male (n=150)	Female (n=150)	*p*-value
FVC(L)	3.00 ±0.44	2.34 ±0.35	<0.001
FEV1(L)	2.82 ±0.43	2.21 ±0.37	<0.001
FEV1/FVC(%)	93.48±7.12	93.92±6.63	0.580

Results were expressed as mean±SD N= total number of subjects
FVC=Forced Vital Capacity,
FEV1=Forced Expiratory Volumein 1st second

Table 3: Correlation coefficient of FVC, FEV1 and FEV1/FVC versus height and weight in subjects (N=300)

		FVC		FEV1		FEV1/FVC	
		Male	Female	Male	Female	Male	Female
Height	rvalue	0.485	0.466	0.463	0.475	0.062	0.219
	p value	<0.001	<0.001	<0.001	<0.001	0.452	0.007
Weight	rvalue	0.475	0.275	0.360	0.238	-0.174	0.017
	p value	<0.001	0.001	<0.001	0.003	0.033	0.833

Pearson's correlation coefficient (r) test was performed to compare relationship between parameters of study group, N= total number of subjects.

The test of significance was calculated and *p*-value<0.05was accepted as level of significance

DISCUSSION

The most important independent factor affecting lung function parameters is height. In our study, it was found to affect all the parameters by a positive relationship. Many other studies found similar type of relationship between lung function parameters and height. For example Dasgupta et al. found a positive relationship between lung function parameters and height in their study conducted on healthy adults from eastern India[12]. Study explained lung function increases with height because increase in height causes increase in diameter of chest and thoracic area. Which results in an increase in total surface area of lungs. So, in taller people, there is more area for exchange of air than shorter people and this causes an increase in lung function[13].

On comparing (appendix i and appendix ii) our results showed lower mean values for FVC and FEV1 than Caucasian, African, Indian and Pakistani population. The highest value for FVC and FEV1 was observed in Caucasian population. This could be explained by the fact that Caucasians have larger trunk to leg ratio at a given height which is caused by genetic factors that might control their body shape[14]. Our mean values were also less than African and Pakistani population, this may be due to less mean height. Other factors that may also influence the parameters are, environmental factors like nutrition, exercise, air quality and occupational exposure. Our results were almost similar to Indian population this may be due to similar height, weight and same environmental exposure [15].

The values for FEV1/FVC ratio were higher or almost similar in our study than other ethnic groups. Our mean value was higher than Caucasian population and similar to Indian, Pakistani and African population. This is because the differences in FEV1 and FVC between ethnic groups

are proportional and independent of age. According to ATS statement most races show similar or higher FEV1/FVC ratio than Caucasians. As FEV1/FVC ratio depends on the ratio between the maximum effort in the 1st second (needed for FEV1) and a sustained effort which is needed for the whole FVC. The FVC is better in Caucasians than other ethnic groups which results in a low ratio of FEV1/FVC[16-19].

CONCLUSION

The present study estimated the values of FVC, FEV1 and FEV1/FVC ratio of healthy Bangladeshi adult population residing in Dhaka city. This study revealed that the parameters positively correlated with height and weight of subjects and did not show significant correlation with age of subjects. This study may be considered as a visionary contributing step towards determining the parameters' value for reference in this country. More such studies in other parts of Bangladesh needs to be carried out. Data from such studies may be compiled to eventually develop a reference value for the above parameters which would be more specific for healthy adult population of Bangladesh.

Appendix i: Comparison of the current study with other studies: male subjects

Authors(year)	Ethnicity	Subjects n	Age range years	FVC (L)	FEV1 (L)	FEV1/ FVC (%)
Currentstudy	Bangladeshi	150	18–45	3.00	2.82	93
Fulambarkeret al.[17]	Indian	226	20–80	3.69	3.02	81
Hankinsonetal.[18]	Caucasian	898	08-80	5.02	3.95	77
Musafirietal.[19]	African	358	18-80	4.13	3.50	84
Memonet al.[20]	Pakistani	321	15-65	3.95	3.01	81

FVC=Forced Vital Capacity
FEV1=ForcedExpiratoryVolumein 1st second n = number of subjects

Appendix ii: Comparison of the current study with other studies : female subjects

FVC=Forced Vital Capacity

Authors(year)	Ethnicity	Subjects n	Age range years	FVC (L)	FEV1 (L)	FEV1/ FVC (%)
Currentstudy	Bangladeshi	150	18–45	2.34	2.21	93
Ashoketal. (2004)	Indian	137	20–80	2.55	2.12	83
Hankinsonetal.(1999)	Caucasian	594	08-80	3.75	3.01	80
Musafirietal.(2012)	African	392	18-80	2.97	2.55	85
Memonetal. (2007)	Pakistani	183	15-65	3.88	2.88	79

FEV1=ForcedExpiratoryVolumein1stsecond. n= number of subjects

Lung function parameters in healthy adults of Dhaka

CONFLICT OF INTEREST

There is no conflict of interest.

REFERENCES

1. Chhabra SK, Kumar R, Gupta U, Rahman M, Dash DJ. Prediction equations for spirometry in adults from northern India. Indian J Chest Dis Allied Sci. 2014;56(4):221-9. Erratum in: Indian J Chest Dis Allied Sci. 2015;57(3):204.

2. Miller MR, Hankinson J, Brusasco V, Burgos F, Casaburi R, Coates A, et al. Standardisation of spirometry. Eur Respir J. 2005;26(2):319-38. doi: 10.1183/09031936.05.00034805. PMID: 16055882.

3. Hankinson JL, Odencrantz JR, Fedan KB. Spirometric reference values from a sample of the general U.S. population. Am J Respir Crit Care Med. 1999;159(1):179-87. doi: 10.1164/ajrccm.159.1.9712108.

4. Stanojevic S, Wade A, Stocks J. Reference values for lung function: past, present and future. Eur Respir J. 2010;36(1):12-9. doi: 10.1183/09031936.00143209.

5. Quanjer PH, Stanojevic S, Cole TJ, Baur X, Hall GL, Culver BH, et al. Multi-ethnic reference values for spirometry for the 3-95-yr age range: the global lung function 2012 equations. Eur Respir J. 2012 ;40(6):1324-43. doi: 10.1183/09031936.00080312.

6. MooreVC. Spirometry: step bystep. Breathe.2012; 8 (3):233-40.

7. Choudhury S, Alam MS, Begum QN. Lung function parameters of Bangladeshi male subjects in different living conditions. Bangladesh Med Res Counc Bull. 1997;23(1):30-3.

8. Power and Participation Research Centre (PPRC).Bangladesh 2016 politics, governance and middle income aspirations realities and challenges: An empirical study.PPRC:Dhaka..2016.Available from:http://www.bd.undp.org/content/dam/bangladesh/docs/Publications/Pub2016/policy%20brief.pdf[(Accessed on 3rd April 2024)]

9. SiddiquiK, Ahmed J, Siddique K, Huq S, Hossain A, Doula SN et al.SocialformationinDhaka,1985-2005:Alongitudinalstudyofsocietyinathird worldmegacity.1st ed.Routledge ,Taylor & Francis Group:Oxfordshire.2010.Available from:https://www.routledge.com/Social-Formation-in-Dhaka-1985-2005-A-Longitudinal-Study-of-Society-in/Siddiqui-Ahmed-Siddique-Huq-Hossain-Nazimud-Doula-Rezawana/p/book/9781409411031. [(Accessed on 3rd May 2024)]

10. Bangladesh Bureau of Statistics (BBS).Census of slum areas and floating population.BBS:Dhaka. .2014.Available from:http://203.112.218.65:8008/WebTestApplication/userfiles/Image/Slum/FloatingPopulation2014.pdf. [(Accessed on 14th May 2024)]

11. Abbasi IN, Ahsan A, Nafees AA. Correlation of respiratory symptoms and spirometric lung patterns in a rural community setting, Sindh, Pakistan: a cross sectional survey. BMC Pulm Med. 2012;12:81. doi: 10.1186/1471-2466-12-81.

12. Dasgupta A, Ghoshal AG, Mukhopadhyay A, Kundu S, Mukherjee S, Roychowdhury S, Dhar R, Sengupta S. Reference equation for spirometry interpretation for Eastern India. Lung India. 2015 Jan-Feb;32(1):34-9. doi: 10.4103/0970-2113.148443.

13. Bhatti U, Rani K, Memon MQ. Variation in lung volumes and capacities among young males in relation to height. J Ayub Med Coll Abbottabad. 2014;26(2):200-2. Hankinson JL, Odencrantz JR, Fedan KB. Spirometric reference values from a sample of the general U.S. population. Am J Respir Crit Care Med. 1999; 159(1):179-87. doi: 10.1164/ajrccm.159.1.9712108.

14. Ostrowski S, Barud W. Factors influencing lung function: are the predicted values for spirometry reliable enough? J Physiol Pharmacol. 2006;57 Suppl 4:263-71.

15. Quanjer PH, Stanojevic S, Cole TJ, Baur X, Hall GL, Culver BH, et al. Multi-ethnic reference values for spirometry for the 3-95-yr age range: the global lung function 2012 equations. Eur Respir J. 2012; 40(6):1324-43. doi: 10.1183/09031936.00080312.

16. Fulambarker A, Copur AS, Javeri A, Jere S, Cohen ME. Reference values for pulmonary function in Asian Indians living in the United States. Chest. 2004;126(4):1225-33. doi: 10.1378/chest.126.4.1225.

17. Hankinson JL, Odencrantz JR, Fedan KB. Spirometric reference values from a sample of the general U.S. population. Am J Respir Crit Care Med. 1999; 159 (1) : 179-87. doi: 10.1164/ajrccm.159.1.9712108.

18. Musafiri S, van Meerbeeck JP, Musango L, Derom E, Brusselle G, Joos G,et al. Spirometric reference values for an East-African population. Respiration. 2013;85(4):297-304. doi: 10.1159/000337256.

19. Memon MA, Sandila MP, Ahmed ST. Spirometric reference values in healthy, non-smoking, urban Pakistani population. J Pak Med Assoc. 2007;57(4):193-5.