Biomedical & Pharmacology Journal Vol. **4**(1), 195-199 (2011)

Ventilatory Functions of Indian Adults: A Comparative Study with the European Predictions

SHAHABUDDIN T. SHAIKH[1]*, ASHFAK A. H SAYED[2], KHAN M. MOIZUDDIN[2] and AMARNATH B. SOLEPURE[3]

[1]Department of Physiology, Dr Ulhas Patil Medical College, Jalgaon (India).
[2]Department of Physiology, MGM Medical College, Aurangabad (India).
[3]Department of Physiology, Government Medical College, Aurangabad (India).
E-mail: dr_shahabshaikh@yahoo.co.uk

(Received: May 01, 2011; Accepted: June 20, 2011)

ABSTRACT

Objective

The aim of this cross sectional study was to study Pulmonary Function Test (PFT) parameters in Indian adults between age group 20 to 40 years, and to compare with the prediction equations issued by European Community for steel and Coal (ECSC).

Method

PFT parameters Forced Vital capacity (FVC), Residual volume (RV), Total Lung Capacity (TLC), Maximal Expiratory Pressure (MEP), Maximal Inspiratory Pressure (MIP), and Airway Resistance (Raw) were determined in 381 healthy non smokers of either sex between the age group 20 to 40 years residing in Marathwada region. The parameters were recorded using Medgraphics Body Plethysmograph, Elite DX Model No - 830001-005.

Results

For males, the differences in means of our and predicted values in liters for FVC, RV, TLC, MEP, MIP and Raw are 4.52 and 4.54, 2.00 and 1.69, 6.09 and 6.53, 157.09 and 196.22, -108.68 and –124.77, 1.19 and 2.24 respectively. For Females, the differences in means of our and predicted values in liters for FVC, RV, TLC, MEP, MIP and Raw are 2.59 and 3.49, 2.16 and 1.34, 4.68 and 4.86, 45.69 and 160.29, -65.16 and –91.76, 1.03 and 1.79 respectively.

Conclusion

Healthy Indians had consistently lower values of FVC, TLC, MEP, MIP and Raw, but higher values of RV than the ECSC recommendations in either sex. The ECSC recommended prediction equations may not be used for the Indian population. Population specific prediction equation should be derived for the Indian population after a large scale study.

Key words: India, Pulmonary Function Test, prediction equation, Spirometry.

INTRODUCTION

It is a common practice for the results of lung functions to be interpreted in relation to reference values and in terms whether or not they are considered to be within normal range. PFT reference values are results obtained from quantified studies in healthy nonsmokers.[1]

Due to differences among the population and technical and procedural issues, equations used to predict normal lung functions are diverse. Reference values were often chosen because they were available in the PFT equipment of the laboratories, rather than they had been analyzed and found to be the best for the local population.[2,3] The inappropriate use of control data obtained from non-native populations regarding variations in physical fitness and genetic factors is a major cause of misinterpreting PFT results.[4] If the variability of

the results can be diminished and the measurement accuracy can be improved, the range of normal values for populations can be narrowed and abnormalities more easily detected.[5] Study by American thoracic Society (ATS) has postulated the difference in PFT amongst different ethnic groups is due mainly to differences in respiratory muscle strength, fat-free mass and chest dimensions.[6] Indians have generally lower maximal respiratory pressures as compared with others namely Caucasians and Chinese.[7]

The primary objective of this study was to measure Respiratory pressures (MIP & MEP), FVC, TLC, Raw and RV in a group of healthy men and women residing in central Indian region with an age range of 20 to 40 yr, in order to compare them with the machine generated (western) predicted values.

METHODS

The present cross sectional study was conducted at Department of Physiology, Govt. Medical College, Aurangabad, a tertiary care teaching institute in Maharashtra region of India from August 2009 to December 2010.

The sample size estimated were 400 subjects between the age group of 20 to 40 years of either sex residing in Marathwada region. Only Healthy, asymptomatic, life long non smoking subjects were included for the test as per the guidelines of American Thoracic Society.[1]

A Total of 408 randomly selected subjects from the society were explained the background of the study out of which 397 turned out to enroll themselves for the study. Detailed explanation of the purpose and methodology of the test was given to all subjects. 16 subjects were excluded, 10 were smokers, 2 had history of intense athletic activity and 4 had family history of cardiopulmonary disease. Total 381 subjects were selected as participants. Informed written consents were obtained form these participants. Appointments were given to five subjects per day.

Pulmonary function test were recorded using Medgraphics Body Plethismograph, Elite DX Model No-830001-005 by Medical Graphics Corporation, St. Paul, Minnesota, USA after volume calibration at 3 liters and temperature calibration at room temperature to give values at BTPS. Subjects were encouraged persistently for maximum efforts. Three readings were taken and the best of three readings were recorded for analysis. The European Respiratory Society's prediction equations, which represent those of the European Community for Steel and Coal, were used. Following parameters were measured and their values, (actual values) were compared with predicted values.

- Maximum expiratory pressure (MEP)
- Maximum inspiratory pressure (MIP)
- Forced vital capacity (FVC)
- Total lung capacity (TLC)
- Residual volume (RV)
- Airway resistance (RAW)

Statistical method

The subjects were divided according to their gender. Mean, standard deviation, of the study sample (observed value) was calculated and compared with the predicted value using independent sample't' test. Statistical significance of the difference was seen by calculating two-tailed significance.

The data was analyzed using SPSS for windows software, release 9.0.0. Independent sample't' test was applied for comparison of each parameter with its predicted.

RESULTS

Total of 381 normal subjects of either sex, ranging from age group of 20 to 40 were studied. The mean age, height and weight of the subjects in the study group was as shown in the table 1.

The difference in actual and predicted values for the studied parameters in males was as shown in table 2. The differences found were statistically highly significant (p value<0.001) except FVC in which the difference was statistically not significant (p value>0.05).

For females the difference was as shown in table 3. The differences found were statistically highly significant (p value<0.001) except TLC in

Table 1: Physical characteristics of the study group

Parameter	Males (n = 216)	Females (n = 165)	All N = 381
Age (years)	32.29 ± 3.50	31.06 ± 2.98	31.675
Height (cms)	170.78 ± 6.45	156.62 ± 7.45	163.7
Weight (kgs)	67.39 ± 11.57	51.83 ± 4.77	59.61

Table 2: Comparison of Lung function tests in males with their predicted values derived from the European equations

	Actual Mean±SD	Predicted Mean±SD	P Value
FVC(lits)	4.52±0.45	4.54±0.65	0.692
RV(lits)	2.00±0.12	1.69±0.10	0.00
TLC(lits)	6.09±0.53	6.53±0.53	0.00
MEP(cms/H_2o)	157.09±5.87	196.22±33.04	0.00
MIP(cms/H_2o)	-108.68±3.61	-124.77±0.63	0.00
Raw(cms/H_2o/sec)	1.19±0.11	2.24±0.01	0.00

Table 3: Comparison of Lung function tests in females with their predicted values derived from the European equations

	Actual Mean±SD	Predicted Mean±SD	P Value
FVC (lits)	2.59±0.28	3.49±0.90	0.00
RV (lits)	2.16±0.24	1.34±0.18	0.00
TLC (lits)	4.68±0.48	4.86±0.63	0.005
MEP (cms/H_2o)	45.69±4.61	160.29±30.50	0.00
MIP (cms/H_2o)	-65.16±0.63	-91.76±15.28	0.00
Raw (cms/H_2o/sec)	1.03±0.008	1.79±0.14	0.00

which the difference was statistically significant (p value <0.05).

All the pulmonary functions in the native population, except RV showed a decline when compared with their predicted. Comparatively RV volume was higher than the predicted values. These differences were statistically highly significant. (P value<0.001)

DISCUSSION

Respiratory muscle pressures i.e. MEP & MIP are an indicator of respiratory muscle strength[8-10]. Our study indicates that Indians had lesser muscular strength than the subjects in the computer generated modules. Similar results were reported in studies by John A *et al.*,[7].

The study sample also had higher Residual Volumes than the predicted values. This could be the effect of poor muscular strength resulting in inability to expire to the maximum during normal breathing as compared to predicted values, and therefore resulting in higher residual volumes. Study by Kreitzer SM et al indicates that RV is normal or increased especially in expiratory muscle weakness[11].

The observed values for the FVC, TLC were lower than the predicted values for the study sample and the difference is highly significant ($p<0.001$). In a study by Donnelly PM et al which tried to explain the racial difference in lung volumes, it was observed that Caucasians (western population) have physically large chest cavities and increased number of alveoli than the Indians which accounted for the increased lung volumes.[12] The observation made by Yap WS et al explains the ethnic difference in lung volumes by measuring the upper body segment length and thoracic size. [13] In their study, 1250 subjects between 20-90 yrs were studied. They found out the ratio of sitting height to standing height. Their findings showed a significant difference of ratios, Chinese - 0.539, Malays – 0.529, Indians – 0.518. This paralleled the ethnic difference in lung volumes. Mengesha et al reported that Indians have the poorest pulmonary functions among all races studied. Caucasians had the best pulmonary function followed by the Africans, Chinese and Indians. [14] Similar observations were made by Giri B R et.al in which the muscularity effect on various ventilatory parameters was observed.[15]

The lower ventilatory functions of our study subjects could be explained on the basis of their poor muscle strength as is evident from their MEP and MIP. However Johan A et.al in their study refutes that the ethnic difference in respiratory muscle strength can explain the difference in lung volumes .[7]

In the Indian population, airway resistance was observed to be less than the values predicted. Generally the airway resistance is dependent inversely on the lung volume i.e. airway resistance is high at low lung volumes and decreases sharply as the lung volumes increase.[16,17]

Our observation was contrary to the above studies. Amongst the parameters studied by us while all the observations were in line with the observation made by earlier studies,[14,7,12] the observed decreased airway resistance amongst the Indian population was unexpected and needs to be explored on a large scale study. The decreased airway resistance could be a result of process of adaptation whereby airway resistance would compensate for the other wise poor pulmonary functions in the study group. This partly explains the relative healthy conditions of the study subjects in spite of lower lung functions as compared to the predicted values derived from the prediction equations of the European population.

CONCLUSION

The pulmonary function test values in the population from the Indian region were much lower compared to the predicted value of the European population. Therefore we suggest that reference equations, derived after a large scale study from the native population, should be used instead of using the European prediction equation.

REFERENCES

1 The official statement of ATS: Lung function testing: selection of reference values and interpretative strategies. *Am Rev Respir Dis*: **144**: 1202-1218 (1991).

2 Pattishall EN. Pulmonary function testing reference values and interpretations in pediatric training programs. *Pediatrics* **85**: 768-773 (1990).

3 Stevens WH, van Hartevelt JH, The PE, Smink HA, Quanjer PH. Validity of ECSC prediction Equations for spirometric indices in dutch conscripts. *Eur Respir J*; **7**: 29-34 (1994).

4 Becklake MR. concepts of normality applied to the measurement of lung function. *Am J Med* **80**: 1158-63 (1996).

5 M.R. Miller, J. Hankinson, V. Brusasco, F. Burgos, R. Casaburi, A. Coates, R. Crapo, P. Enright, C.P.M. van der Grinten, P. Gustafsson, R. Jensen, D.C. Johnson, N. MacIntyre, R. McKay, D. Navajas, O.F. Pedersen, R. Pellegrino, G. Viegi and J. Wanger. "ATS/ERS task force: Standardisation of Lung Function testing". *Eur Respir J* **26**: 319-338 (2005).

6 American Thoracic Society. Lung tunction

testing: selection of reference values and interpretative strategies. *Am Rev Respir Dis*; **144**: 1202–1218 (1991).

7 Johan A, Chan CC, Chia HP, Chan OY, Wang YT. Maximal respiratory pressures in adult Chinese, Malays and Indians. *Eur Respir J* **10**(12): 2825-2828 (1997).

8 Karvonen, J., S. Soarelainen, and M. M. Nieminen., Measurement of respiratory muscle forces based on maximal inspiratory and expiratory pressures. Respiration **61**: 28-31 (1994).

9 Enright, P. L., R. A. Kronmal, T. A. Manolio, M. B. Schenker, and R. E. Hyatt., Respiratory muscle strength in the elderly. *Am. J. Respir. Crit. Care Med*. **149**: 430–438 (1994).

10 Aldrich, T. K., and P. Spiro., Maximal inspiratory pressure: does reproducibility indicate full effort? *Thorax* **50**: 40-43 (1995).

11 Kreitzer SM, Saunders NA, Tyler HR, Ingram RH. Respiratory muscle function in amyotrophic lateral sclerosis. *Am Rev Respir Dis*, **117**: 437-447 (1978).

12 Donnelly PM, Yang TS, Peat JK, Woolcock AJ. What factors explain racial differences in lung volumes?. *Eur Respir J,* **4**(7): 829-38 (1991).

13 Yap WS, Chan CC, Wang YT. Ethnic differences in anthropometry among adult Singaporean Chinese, Malays and Indians, and their effects on lung volumes. *Respir Med.* **95**(4): 297-304 (2001).

14 Mengesha YA, Mekonnen Y; Spirometric lung function tests in normal non smoking Ethiopian men and women: Thorax. **40**(6): 465-468 (1985).

15 Giri BR, Sharma BK, Jindal SK: Normal spirometry in healthy natives of Bhutan; *J Assoc Physicians India.* **44**(5): 320-322 (1996).

16 Quanjer PH, Stocks J, Polgar G, Wise M, Karlberg J, Borsboom G. Complication of reference values for lung function measurement in children. *Eur Resp J* (Suppl): 184-261 (1989).

17 Marshall R. The physical properties of the lungs in relation to the subdivisions of lung volume. Clin Sci (Lond). **16**(3): 507-515 (1957).