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Original Research Article

A comparative study of pulmonary function in healthy male and female subjects of western Rajasthan

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Abstract: Pulmonary function tests are used to measure baseline status of respiratory function, to monitor treatment and to estimate prognosis. The present study was aimed to determine pulmonary function tests values and to compare the different parameters like FVC, FEV_1, FEV_1/FVC, $FEF_{25-75\%}$, PEFR and MVV in healthy male and female subjects of western Rajasthan. The study included 150 subjects of age range from 20 to 75 years above. Out of these 150 subjects 75 were males and 75 were females. Pulmonary function tests were done with the help of computerized spirometer. Different parameters like FVC, FEV_1, FEV_1/FVC, $FEF_{25-75\%}$, PEFR and MVV were recorded. The results showed that all parameter were higher in males, when compared with females. Statistical significance was obtained by using t- test ($P<0.001$). It is probably a result of increase strength of expiratory muscles and increase chest wall compliance in males than females.
Keywords: Male, Female, Pulmonary Function Tests.

INTRODUCTION

Pulmonary function tests are very helpful in the diagnosis, management and follow up of respiratory disorders, yet they have not gained the required popularity and place in the diagnostic armamentorium of respiratory disease. Pulmonary function tests are affected by many factors like, age, sex, height and race and body surface area of the individuals. Few studies have been conducted by Indian workers to established norms of pulmonary function tests in healthy adults of western Rajasthan (A desert state of India). India is a subcontinent with varying geography and with a large multi-ethnic population. Since the pulmonary function tests are affected in one way or other in most of the pulmonary diseases clinicians must know the pulmonary function tests in order to arrive at an accurate diagnosis. Pulmonary function test provide objective evidences of the nature and severity of lung disease. Pulmonary function tests are important not only in the diagnosis of pulmonary diseases but also in assessing the effect of drug and follow up of the disease prognosis. Even within the country ventilatory function of the lung show wide variation in people having similar socioeconomic environment but belonging to different regional areas and ethnic status [1-3]. Changes in chest wall compliance lead to a greater contribution to breathing from the diaphragm and abdominal muscles and a lesser contribution from thoracic muscles. The age-related reduction in chest-wall compliance is somewhat greater than the increase in lung compliance; thus, compliance of the respiratory system is 20% less in a 60-year-old subject compared with a 20-years-old [4].

Significant variables affecting the standards for ventilatory function include age, height, sex, size of the sample tested, racial and ethnic composition, criteria for normality, tobacco smoking, environmental conditions and altitude of residence, apparatus and techniques [5].Ventilatory function tests provide a better understanding of functional changes in the lungs and their significance from the view point of diagnosis. Therefore the present study was done to establish the lung function tests in healthy non-smoking male and female subjects of western Rajasthan and to find out relationships of lung function with gender of healthy people in western Rajasthan.

MATERIAL AND METHODS

This study was conducted at Department of Physiology, Dr. S.N. Medical College Jodhpur with the permission of institutional ethics committee. In this study included 150 healthy subjects of both sex (i.e. 75 males: 75 females) with age ranging from 20-70 years

above.

Subjects were all healthy, non-smokers, didn't have any respiratory diseases were included. The participants having respiratory problems such as Bronchial asthma, Chronic Obstructive lung disease, Tuberculosis, Post Tuberculosis sequelae and valvular heart disease, Undergone any abdominal surgery, acute illness and smokers were excluded. The female participants with pregnancy also were excluded from the study. Consent was taken from all the participants before conducting the study.

Pulmonary Function Tests

Pulmonary function of the subject was measured by computerized spirometer (SpiroExcel, Medicare Systems).

Two maneuvers namely Forced Vital Capacity (FVC) and Maximum Voluntary Ventilation (MVV) were needed to deduce the desired pulmonary function values. Pulmonary function test was performed in sitting position. Before recording the Pulmonary Function Tests, subjects were shown demonstration of the tests. The test was applied at least three times and highest values were recorded.

For FVC test subject was asked to blow out as hard and fast as possible and to continue blowing until no more air can be exhaled. It was ensured that a tight seal would maintain between the lips and mouthpiece of the spirometer. Then the subject was instructed to take another deep breathe in, with the mouthpiece still in his mouth, until the lungs were full with air. When finished the effort/manoeuvre was completed. The FVC screen showed flow/volume and volume/time graphics and important parameters i.e. Forced vital capacity (FVC), Forced expiratory volume in 1st second (FEV_1), ratio of FEV_1 to FVC (FEV_1/FVC), Peak expiratory flow rate (PEFR), forced expiratory flow rates during 25%-75% of expiration ($FEF_{25-75\%}$), Maximum voluntary ventilation (MVV) were measured.

For MVV test subject was instructed to breathe in and out as rapidly and deeply as he can with his maximum muscular efforts for a period of 15 seconds in the mouthpiece of the spirometer with both his nostrils closed. The predicted value and the actual value of the performed test were displayed.

Analysis of data

All data were expressed as mean ± SD and were statistically analysed by using the Microsoft Excel and OpenEpi software (version 2.3.1).

RESULT:

From our study it is evident that all parameters like FVC, FEV_1, PEFR, $FEF_{25\%-75\%}$ and MVV were higher in males, when compared with females and statistically highly significant ($p<0.01$). FEV_1/FVC ratio is higher in females than males and statistically significant ($p<0.05$) shown in this table-1.

Table 1: Comparison and Statistical analysis of pulmonary function between male and female subjects

Parameters	Males(n=75)	Females(n=75)	p-value
	Mean ± SD	Mean ± SD	
FVC(L)	2.87 ± 0.87	2.07 ± 0.70	<0.01
FEV_1(L)	2.45 ± 0.82	1.82 ± 0.61	<0.01
FEV_1/FVC (%)	85.16 ± 8.13	87.80 ± 8.18	<0.05
$FEF_{25-75\%}$ (L/sec.)	3.57 ± 1.50	2.69 ± 1.04	<0.01
PEFR (L/sec.)	5.56 ± 2.70	3.98 ± 1.60	<0.01
MVV (L/min.)	70.41 ± 33.57	52.23 ± 24.71	<0.01

(p<0.01=highly significance, p<0.05=Significance)

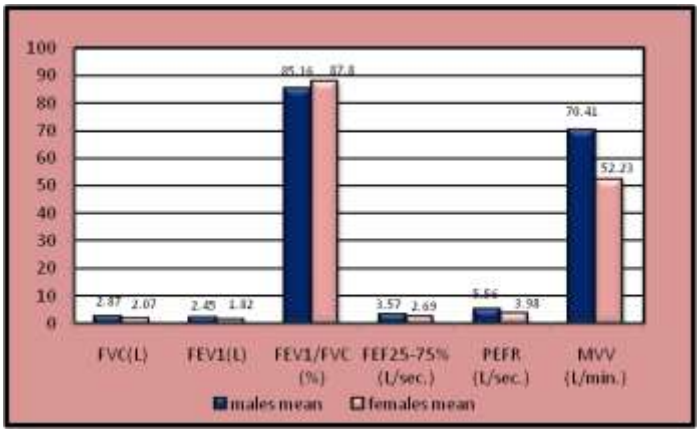

Fig 1: Mean value of pulmonary function test in male and female

DISCUSSION:

The present study observed that mean value of all respiratory parameters was more in males as compared to females. Thereafter the values were comparatively higher in males then females.

Our study reveal following important observation about mean FVC values was higher in males and lower in females. It was found statistically highly significant ($p<0.01$). Similar observations have been made by Fulambarker A [6] and Chatterjee and Sahal [7-8]shown in table 2.

FEV_1 mean values showed that more in males then females. Statistically it was highly significant ($p<0.01$). Similar trend was observed in Johannsen and Erasmus [9], Chatterjee and Saha1 [7-8], Fulambarker A [6] shown in table 2. The FEV_1 normally declines about 30ml per years with aging even in healthy men and women without lung disease. Adults normally experience a loss in FEV_1 of about one-third litre per decade. The decline in FEV_1 with aging is greater than the decline in FVC, so that the FEV_1 /FVC also decline with age.

The present study showed important observation for mean values of FEV_1/FVC ratio was slightly higher in females then males and statistically it was significant ($p<0.05$). The results obtained were similar to the study performed by Bandyopadhyay A [10]. Also performed by Neder JA [11] he was divided in to six different groups based on age range from 20 to 80 years and compared the male and female data of FEV_1/FVC ratio.

A comparison with the study of Behera AA [12] was showed that FEV_1/FVC ratio was higher in males as compared to females but the difference is very less and can be considered insignificant. As males have more number of alveoli per unit area and their alveoli are larger and have grater compliance, they are expected to have higher values of PFTs as compared to females [12].

On analysing the result for $FEF_{25-75\%}$ in relation to gender, the mean values show practically same trends as were observed for FVC and FEV_1 in the present study. Meaning there by that these pulmonary function tests (PFT's) was higher in males when compared to females. Flow rates were statistically highly significant ($p<0.01$). Same trend was observed in the study performed by Bandyopadhyay A [10] and Neder JA [11].

Our data indicate that mean value of PEFR was more in males as compared to females and statistically it was found highly significant(<0.01). Similar observation was made by Bandyopadhyay A [10]. Behera AA [12] he was divided in three different age groups from 20-65years and then compared the male and female data of PEFR.

MVV was higher in males and lower in females. This trend was observed in the present study and statistically highly significant ($p<0.01$). The results obtained were similar to the study performed by Vijayan et al [13] shown in table 2.

Many studies like Johannsen and Erasmus [9], Chatterjee and Saha1 (7-8), Neder JA 1999, Behra AA [12] and Fulambarker A [6] have also observed similar results. Normally pulmonary function tests (PFTs) are affected by age, height, sex and race. The values were normally higher in males on comparing of female subjects. Factors such as individuals' circadian rhythm, genetic and biological characteristics, physical activity, muscle structure, race and seasonal changes can also influence PFT results. Errors due to biological difference and technical factors should be eliminated as much as possible [14].

Table 2: Comparison of pulmonary function between male and female subjects by different author

Author name	Sex (n)	Age range (Years)	FVC (L) mean	FEV_1 (L) Mean	FEV_1/ FVC (%) mean	$FEF_{25-75\%}$ (L/sec) mean	PEFR (L/sec) mean	MVV (L/min) mean
Present study (2014)	M (75) F (75)	20-81 20-69	2.87 2.07	2.45 1.82	85.16 87.80	3.57 2.69	5.56 3.98	70.41 52.23
Johannsen and Erasmus [9]	M(120) F (100)	20-50 20-50	4.07 2.74	2.96 2.25	NA	NA	NA	NA
Chatterjee and Sahal [7,8]	M(334) F (230)	20-60 20-59	3.97 2.42	3.23 1.99	NA	NA	NA	NA
Vijayan et al [3]	M(130) F (117)	15-40 15-40	3.99 2.89	3.31 2.39	NA	NA	NA	126.7 77.7
Fulambarker A [6]	M(226) F (137)	20-80 16-80	3.70 2.57	3.07 2.18	NA	NA	NA	NA
Bandyopad-hyay A[10]	M (64) F (64)	20-25 20-25	3.94 2.75	3.55 2.49	90.13 90.86	266.83 204.34 (L/min)	503.56 362.07 (L/min)	NA

CONCLUSION

Our study concluded that values of FVC, FEV_1, $FEF_{25-75\%}$, PEFR and MVV were observed to be higher in males, when compared with females and statistically highly significant ($p<0.01$). Data for FEV_1/FVC ratio is higher in females than males and statistically significant ($p<0.05$). Our results show differences in the respiratory patterns of healthy male and female subjects, suggesting that gender impacts on lung function.

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