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Research Article

Study of Pulmonary Function Test in different age groups of healthy people in Western Rajasthan

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Abstract: The respiratory system changes with age and understanding these changes helps detect and prevent respiratory dysfunctions in the elderly. Pulmonary function, as measured by spirometry is an important predictor of morbidity and mortality of elderly persons. The aim of present study was to see the effect of aging on pulmonary functions in different age groups of healthy people in western Rajasthan. The study included 150 subjects of different age from 20 years and above. Subjects were divided in six groups depending on their age. The results showed that values of FVC, FEV_1, $FEF_{25-75\%}$, PEFR and MVV were observed to be higher in the age group of 20 -30 years. Data for FEV_1/FVC ratio shows that up to 50 years of age this ratio is not much different, but later on in 60 -80 years age group D, group E, group F. Differences in the respiratory patterns of healthy adults and the elderly, suggesting that age impacts on lung function.
Keywords: Aging, FVC, FEV_1, FEV_1 /FVC%, $FEF_{25-75\%}$, PEFR, MVV.

INTRODUCTION

In western Rajasthan, the geographical conditions are of desert, the customs, traditions, food all are different from other states. This geographical reason shows lot of variations in mean height, weight and body surface area in different. Keeping the existing status in mind of small number of studies from India with a lot of age, height, weight and body surface area variability, we undertook present study to establish norms of pulmonary function tests in healthy adults of western Rajasthan. Only these norms if established will be able to help the medical physiologist and clinicians in understanding, correct interpretations, better diagnosis and management of adults suffering from respiratory disorders in this part of our country. 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).

Population aging is a universal phenomenon. The present times have witnessed the increase in life expectancy globally [1] . Aging is the progressive, universal decline first in functional reserve and then in function that occurs in organisms over time. Aging is not a disease; however the risk of developing disease is increased.

The respiratory system changes with age and understanding these changes helps to detect and prevent respiratory dysfunction in the elderly [2]. Lung functions decline throughout adult life, even in healthy persons. Cross sectional analysis have suggested that the decline may go faster after age 70. Normal aging results in changes in pulmonary, mechanics, respiratory muscle strength, gas exchange and ventilator control. Increased rigidity of chest wall and a decrease in respiratory muscle strength with aging result in an increased closing capacity and a decreased forced expiratory volume in first second or FEV_1. After about 20 years, the number of alveoli and the number of the lung capillaries gradually begin to decrease. Although aging affects compliance, lung volume, airflow, diffusing capacity and other parameters of lung function, purely age related changes do not lead to clinically significant. Symptoms or changes in non-smokers [3-5].

Aging is natural process that reduces the number of healthy cells in the body and associated with progressive constriction of the homeostatic reserve of every organ [6]. Ventilator function tests provide a better understanding of functional changes in the lungs and their significance from the view point of diagnosis. The knowledge of pulmonary function tests is a basic requirement to understand the respiratory physiology for all medical physiologist and clinicians. 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. Pulmonary function tests are affected by many factors like, age, sex, height and race and body surface area of the individuals. Therefore the present study was done to establish the age effect on lung function test of healthy non-smoking people in western Rajasthan.

MATERIAL AND METHODS:

The study was carried out on 185 subjects. Out of185 subjects 35 were excluded from this study due to chronic absentees and abnormal data. After exclusion of 35 abnormal subjects 150 subjects were(despite the best efforts) included for present study with 75 (50%) were males and 75(50%) were females (i.e. sex ratio was 1:1). Institutional ethical clearance was obtained before commencement of the study. The study was conducted in the Department of Physiology, Dr. S.N. Medical College Jodhpur.

Inclusion Criteria:

- Both male and female subjects with age ranging from 20-70 years above.
- Normal cardiac and respiratory functions.
- The participants didn't have any acute illnesses like upper respiratory tract infection, lower respiratory tract infection.
- Non- smokers were included.
- Consent was taken from all the participants before conducting the study.

Exclusion Criteria:

- The participants having respiratory problems such as Bronchial asthma, Chronic Obstructive lung disease, Tuberculosis, Post Tuberculosis sequelae etc.
- The participants having valvular heart disease.
- Undergone any abdominal surgery, acute illness, and smokers.
- The female participants with pregnancy.
- BMI not ranging between 17 and 25 were excluded.

Pulmonary Function Tests:

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 using computerized spirometer (Spiro Excel, Medicare Systems).

Pulmonary function of the subject was measured by computerized spirometer (SpiroExcel, Medicare Systems).The instrument is capable of giving highly accurate and reliable test results.

Procedures:

The instrument stores and calculates all the necessary flow and volume parameters. 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. Consequently minimum three readings were recorded of each test for every subject and the best of the three was selected for having reproducibility and validity of the recorded test.

For FVC test after explaining the general procedure to the subjects FVC icon was clicked. Subjects were asked to begin relaxed tidal breathing through the mouth piece (fixed over the transducer) and then to take a deep breath in. Immediately after this the subject was asked to blow out as hard and fast as possible and to continue blowing until no more air can be exhaled. 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/maneuver was completed. The FVC screen showed flow/volume and volume/time graphics and important parameters i.e. FVC, FEV_1, FEV_1/FVC, PEFR, $FEF_{25\%-75\%}$ were simultaneously displayed on screen.

For MVV test the spirometer was switched over to MVV test mode along with the display of the MVV test screen. The 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. At least two acceptable maneuvers (with no more than a 10% difference between them) were obtained and the highest value of MVV was recorded.

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). One-way ANOVA and appropriate post hoc tests (Bonferroni multiple comparisons procedure) were used to determine the statistical difference among parameters. P-values of less than 0.05 indicated a significant difference. ANOVA is used to compare the more than two means.

RESULT:

From our study it is evident that FVC progressively decreases with age and statistically highly significant ($p<0.01$). FEV_1 values were significantly lowered in group C, group D, group E and group F as compared to younger group A. Similar observations have been made by Girgla KK 2012(7) and Vidja K 2013[8] shown inTable 1and Table 2.

Table 1: Shows Statistical analysis of Mean of pulmonary function test (PFT) by ANOVA test for different age group

Groups	**Group- A**	**Group- B**	**Group- C**	**Group- D**	**Group- E**	**Group- F**	***p-value***
Age	**20-30yrs**	**31-40 yrs**	**41-50 yrs**	**51- 60 yrs**	**61-70yrs**	**71- above yrs**	
No. of subjects	**25**	**25**	**25**	**25**	**25**	**25**	
Parameters	**MEAN±SD**	**MEAN±SD**	**MEAN±SD**	**MEAN±SD**	**MEAN±SD**	**MEAN±SD**	
FVC (L)	3.35±0.52	3.15±0.71	2.63±0.67	2.0±0.44	2.02±0.55	1.58±0.53	<0.01***
FEV_1 (L)	2.85±0.48	2.77±0.62	2.33±0.62	1.89±0.56	1.76±0.39	1.24±0.4	<0.01***
FEV_1/FVC (%)	85.04±6.06	88.27±6.58	88.9±6.9	90.23±9.53	86.97±8.01	80.68±9.84	<0.01***
$FEF_{25\text{-}75\%}$(L/sec)	4±1.18	4.18±1.09	3.8±1.32	2.92±1.03	2.52±0.78	1.63±0.67	<0.01***
PEFR (L/sec)	6.6±1.61	6.58±2.3	5.31±1.7	4.63±2.32	3.37±1.07	2.17±0.86	<0.01***
MVV (L/min.)	89.63±27.5	87.09±19.6	71.65±21.2	49.12±16.8	43.96±16.48	26.35±16.8	<0.01***

Table 2: Comparison of pulmonary function (PFT) test for different age group by different authors

Study (Year)	**Age-group (Yrs.)**	**FVC (L)**	**FEV_1 (L)**	**FEV_1 /FVC (%)**	**FEF 2 5-7 5 % (L/sec.)**	**PEFR (L/sec.)**	**MVV (L/ min.)**
		Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Present Study (2014)	20-30	3. 35 ± 0. 52	2. 85 ± 0. 48	85.04 ± 6. 6	4. 00 ± 1. 18	6. 60 ± 1. 61	89. 63 ± 27. 50
	31-40	3. 15 ± 0. 71	2. 77 ± 0. 62	88.27 ± 6.58	4. 18 ± 1. 09	6. 58 ± 2. 3	87. 09 ± 19. 63
	41-50	2. 63 ± 0. 67	2. 33 ± 0. 62	88.90 ± 6. 9	3. 58 ± 1. 32	5. 31 ± 1. 70	71. 65 ± 21.16
	51-60	2. 09 ± 0. 65	1. 89 ± 0. 68	90. 23 ± 7. 73	2. 92 ± 1. 12	4. 63 ± 2. 06	49. 12 ± 16.46
	61-70	2. 02 ± 0. 55	1. 76 ± 0. 39	86. 97 ± 8. 01	2. 52 ± 0. 78	3. 37 ± 1. 07	43. 96 ± 16.48
	71-above	1. 58 ± 0. 53	1. 24 ± 0. 40	80. 68 ± 9. 84	1. 63 ± 0. 67	2. 17 ± 0. 86	26. 35 ± 16.77
Vidja K [7] (2013)	20-29	4. 33 ± 0. 5	3. 91 ± 0. 6	NA	6. 65 ± 1. 3	9. 81 ± 5. 0	93. 94 ± 12
	30-39	3. 81 ± 0. 4	3. 33 ± 0. 4		4.57 ± 1. 2	7. 48 ± 1. 0	119. 12 ± 9
	40-49	3. 02 ± 0. 5	2. 52 ± 0. 5		3. 34 ± 1. 5	6. 49 ± 1. 9	89. 8 ± 8. 8
	50-59	2. 55 ± 0. 4	2. 02 ± 0. 4		2. 66 ± 1. 2	4. 70 ± 1. 5	75. 96 ±11
	60-69	2. 07 ± 0. 4	1. 49 ± 0. 3		1. 75 ± 0. 6	3. 83 ± 1. 3	69. 97± 10
	70-above	1. 68 ± 0. 4	1. 15 ± 0. 2		1. 58 ± 0. 4	3. 39 ± 1. 6	55. 96 ± 94
Jagia GJ [18] (2013)	11-20		3. 19 ± 0. 819	90. 18 ± 4. 49	NA	NA	NA
	21-30		3. 43 ± 0. 885	89. 26 ± 4. 23			
	31-40		2. 96 ± 0. 632	87. 08 ± 2. 69			
	41-50		2. 56 ± 0. 509	83. 46 ± 2. 79			
Girgla KK[8] (2012)	15-30	2. 83 ± 0. 59	2. 73 ± 0. 53	NA	4. 17 ± 1. 22	6. 37 ± 1. 75	NA
	31-45	2. 59 ± 0. 68	2. 35 ± 0. 57		3. 46 ± 0. 96	6. 17 ± 1. 64	
	46-60	2. 16 ± 0. 69	2. 05 ± 0. 58		2. 64 ± 0. 95	4. 15 ± 1. 93	
	61-above	1. 88 ± 0. 60	1. 60 ± 0. 49		2. 12 ± 1. 04	7. 65 ± 1. 3	

DISCUSSION

Culver and Butler reported that lung function does not necessarily decline in the linear fashion, once thought from age 18 or 20 years. Rather it may reach a maximum in the late 20 years and then decline, but there is variability in older adulthood, depending on lung capacity at the time of lung maturation [9].

Our study reveal following important observation about mean FEV_1 values that FEV_1 decreases with increases in age. Similar observations have been made by, Jagia GJ [18], Girgla KK [7] and Vidja K [8] shown in this table. FEV_1 values were significantly lowered in group C, group D, group E and group F as compared to younger group A.

According to European Community for coal and steel data, no significant change occur in forced expiratory volume in FEV_1 and FVC between the age of 18 and 25 years [19]. After this plateau, FEV_1 and FVC start to decreases [20].

Present study data for FEV_1 /FVC ratio shows that up to 50 years of age this ratio is not much different, but later on in 60-80 years age group D, group E, group F, shows slightly higher values.

Similar observation has been made by Jagia GT[18] was found that the age of 20 to 50 years the ratio of FEV_1 /FVC is not much different.

On analysing the result for $FEF_{25\text{-}75\%}$ in relation to age 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) decreases with increasing in age.

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$FEF_{25\text{-}75\%}$ values decreases as the age of person rises, it was observed in group C onward more significantly, means after 41-50 yrs age flow rate decreases tremendously. Similar observations have been made by Girgla KK [7] and Vidja K [8].

Our data indicate that PEFR values were found statistically significant. PEFR with age shows decreases with increasing in age. Similar observations have been made by Girgla KK [7] and Vidja K [8].

Arora and Rochester [10] shows the deleterious impact of under nourishment on respiratory muscle strength or maximal voluntary ventilation decrease inrespiratory muscle strength and maximal voluntary ventilation was highly significant in under nourished subject.

Kundson et al. [11] shows that lung function decline throughout life, even in healthy person but decline may go fast after age of 70 years.

MVV values decreases significantly as the age of person rises, it was observed in all the groups and it shows significantly different values in all the groups ($p<0.01$). MVV values were significantly lowered in group C, group D, group E and group F as compared to younger group A. Similar observations have been made by Vidja K [8]

Our study also shows a decline in FVC, FEV_1, $FEF_{25\text{-}75\%}$, PEFR and MVV with increment in age. This decline was more after 60 years of age.

Many studies like Bandyopadhyay A [12] and Behra AA [13] have also observed similar results. In all the parameters, it was observed that respiratory system exhibit a dramatically reduced capacity during aging process, especially after 60 years, including a decrease in chest wall compliance, reduction in respiratory muscle strength, decline in expiratory flow rates and reduction in costo-vertebral joint ranges of motion, resulting in increased work of breathing [14]. Some authors reported reduction in the order of 8-10% in respiratory muscle strength beyond age of 40 years [15-17].

CONCLUSION

Our study concluded that values of FVC, FEV_1, $FEF_{25\text{-}75\%}$, PEFR and MVV were observed to be higher in the age group of 20-30 years. Data for FEV_1 /FVC ratio shows that up to 50 years of age this ratio is not much different, but later on in 60-80 years age group D, group E, group F. Our results show differences in the respiratory patterns of healthy adults and the elderly, suggesting that age impacts on lung function.

REFERENCES

1. Caruso LB, Silliman RA; Geriatric Medicine in Fauci AS, Branunwal E Kasper DL, Hauser SL, Longo DL, Jameson JL, Loscalzo J, "Harrison's Principal of Internal Medicine". McGraw-Hill 17th Ed 2008; 2: 53-59.
2. Levitzky MG; Effects of aging on the Respiratory System. The Physiologist 1984; 27(2):0112-1 393.
3. Ehsani AA; Cardiovascular adaption to exercise training in the elderly. Fed Proc, 1987; 46(5):1840-1843.
4. Himann JE, Cunningham DA, Rechnitzer PA; Age-related changes in speed of walking. Med Sci Sports Exerc, 1988; 20(2): 161-166.
5. Roubenoff R; Origins and clinical relevance of sarcopenia. Can J Appl Physiol, 2001; 26(1): 78-89.
6. Janssens JP; Aging of the respiratory system: Impact on PFT and adaptation to exertion. Clin Chest Med, 2005; 26: 469-484.
7. Girgla KK, Kaur D, Kiran; Variation in lung function with age - A local study. International Journal of Basic and Applied Medical Sciences, 2012; 2(2): 148-153.
8. Vidja K, Bhabhor M; A comparative study of

pulmonary function in different age groups. NJIRM May-June 2013; 4(3):0975-9840, 2230-9969.
9. Culver BH, Butler J; Alterations in pulmonary function. In: Principles of Geriatric Medicine Ed Andes R, Bierman EL and Hazzard WR, McGraw Hill Book Co Ltd (London), 1985; 26: 280-287.
10. Arora NS, Rochester DF; Respiratory muscle strength 480 Janssen and maximal voluntary ventilation in undernourished patients. Am Rev Respire Dis, 1982; 126:5–8.
11. Knudson RJ, Lebowitz MD, Holberg CJ; Burrows Changes in the normal maximal expiratory flow-volume curve with growth and aging. Am Rev Respir Dis, 1983; 127: 725-734.
12. Bandyopadhyay A; Pulmonary function studies in young healthy Malaysians of Kelantan, Malaysia. Indian J Med, 2011; 134: 653-657.
13. Behera AA, Behera BK, Dash S, Mishra S; Variation of pulmonary function tests with relation to increasing age in healthy adults. International Journal of Health Sciences and Research, 2014; 4(3): 136-141.
14. Janssens JP; Aging of the respiratory system: Impact on PFT and adaptation to exertion. Clin Chest Med, 2005; 26: 469-484.
15. Chen H, Kuo C; Relationship between respiratory muscle function and age, sex, and other factors. J Appl Physiol, 1989; 66(2): 943-948.
16. McConnell AK, Copestake AJ; Maximum static respiratory pressures in healthy elderly men and women: issues of reproducibility and interpretation. Respiration, 1999; 66(3): 251-258.
17. Neder JA, Andreoni S, Lerario MC; Reference values for lung function tests. II.Maximal respiratory pressures and voluntary ventilation. Braz MedBiol Res, 1999; 32(6):719-72.
18. Jagia GJ, Chandan L; Study of pulmonary function in different age groups. Indian Journal of Basic & Applied Medical Research, 2013;8(2):1138-1145.
19. Quanjer PH, Stanojevic S, Stocks J, Hall GL, Prasad KVV, Cole TJ, Ip MSM; (Changes in the FEV1/FVC ratio during childhood and adolescence: an intercontinental study. European Respiratory Journal, 2010; 36(6):1391-1399.
20. Kerstjens HA, Rijcken B, Schouten JP, Postma DS; Decline of FEV1 by age and smoking status: facts, figures, and fallacies. Thorax, 1997; 52(9):820.