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ORIGINAL RESEARCH

A spirometric study in normal healthy, Punjabi population and its correlation with age- an observational study

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ABSTRACT

Background

Pulmonary function tests (PFTs) is important for assessment of the fitness of an individual and serve as a tool of respiratory health assessment. The present spirometric study was conducted in normal healthy, Punjabi population and to correlate it with age.

Material & methods

The present study was conducted in the Department of Physiology, Government Medical College, Patiala, Punjab. This study included 200 healthy population of 50 years and above years of age. A detailed physical examination and different lung function tests were carried out. Mean, standard deviation and standard error of mean and coefficient of variation was calculated and the same represented by tables**.**

Results

Mean FEV0.5/FVC% was higher in age group 50-59 years, Mean FEV3/FVC% higher in age group 50-59 years. Mean FVC, Mean Fev0.5, mean FEV1, mean FEV3 was higher in males of age group 50-59 years as compared to 60 and above age group. Mean FEV1/FVC% was higher in 80 and above age group whereas less in age group below 80 years. Mean FEV0.5/FVC%, mean FEV1/FVC%, mean FEV3/FVC% was higher in males of age group 50-59 years age group as compared to 60 and above age group. Mean FEV0.5/FVC%, mean FEV1/FVC%, mean FEV3/FVC% was higher in females of age group 50-59 years age group as compared to 60 and above age group.

Conclusion

The study concluded that Mean FEV0.5/FVC% was higher in age group 50-59 years, Mean FEV3/FVC% higher in age group 50-59 years as compared to 60 and above age group. Mean FEV1/FVC% was higher in 80 and above age group whereas less in age group below 80 years. In males and females Mean FVC, Mean Fev0.5, mean FEV1, mean FEV3 was higher in age group 50-59 years as compared to 60 and above age group.

Keywords

FEV, FVC, MVV, spirometry.

Introduction

Pulmonary function tests (PFTs) have developed from tools for carrying out physiological studies to clinical tools for the identification, management, and follow-up of respiratory illnesses, because they can be used to give objective information about the status of an individual respiratory system.[1] PFTs determine lungs capacity of holding air, quantity of air going in and out, and how well lungs take in

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oxygen and give out carbon dioxide from blood. Spirometery being the most commonly peformed lung function test is considered as the first choice in diagnosis of lung pathology. Spirometery is a technique used to measure amount and flow of air inhaled and exhaled and the lung functions. It measures amount of air that can be moved in and out of one's lungs.[2] It is well-known that differences in pulmonary function in normal people may be due to ethnic origin, tobacco smoking, age, height, sex, and socioeconomic status.[3] PFTs are also affected by physical activity, environmental conditions, and altitude changes. In a large country like India wide range of geographical and climatic conditions may be associated with regional differences in lung function in healthy individuals.[4] The present spirometric study was conducted in normal healthy, Punjabi population and to correlate it with age.

Material and Methods

The present study was conducted in the Department of Physiology, Government Medical College, Patiala, Punjab. This study included 200 healthy population of 50 years and above years of age who had responded favourably to our appeal for co-operation in carrying out this investigation. The subjects have been drawn from amongst healthy residents of Patiala. People belonging to all socio-economic strata of the community had been adequately represented. The subjects had been judged to be healthy on the following criteria.

- No history of smoking.
- No history, current or past, of any cardio respiratory disorder or frequent colds.
- No exertions dyspnoea or general debility.
- No obvious signs of malnutrition or skeletal deformity.
- No obesity.

A detailed physical examination was carried out to rule out any cardio-respiratory disorder. In all subjects haemoglobin estimation was done and persons with normal haemoglobin level were judged healthy. The decision whether or not to be included a given subject in the present investigation was taken before function testing. Once included, none was subsequently rejected except when he was unable to give the desired co-operation in the experimental procedures.

The terminology and abbreviations used for different lung function tests carried out were as suggested by Gandevia and Hughjones (1957) and Cotes (1965).

		Abbreviations
1.	Body Surface Area.	B.S.A
2.	Forced Vital Capacity.	F.V.C
3.	Forced expiratory volumes over fixed time intervals.	F.E.V.t t = 0.5, 1.0 and 3seconds
4.	Forced expiratory volume (timed) to forced vital capacity ratio expressed as percentage	F.E.V. 0.5/FVC% FEV 1.0/FVC% FEV3.0/FVC%
5.	Maximum Voluntary Ventilation.	M.V.V.

Spirometer: The ventilatory tests were measured with a computerized spirometer 'Medspiror'. It is designed to be used with electromechanical pneumotach. Built in printer permits print-outs containing all patient information and calculated values of all 14 parameters.

Volume detection was done by pneumotach sensor and flow detection by volume differential method. It's overall accuracy is within+ 1% and it's range for volume is 0 to 10 litres and for flow is 0 to 20 litrs/second.

Testing procedures were quite simple from the patient's point of view. Only two manoeuvres were required to accumulate all test data, a forced vital capacity and a maximum voluntary ventilation. All gas volumes were corrected to B.T. P.S. (body temprature, ambient pressure and saturated with water vapour) automatically by the instrument.

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Technique: Tests were performed in the laboratory. Tests were carried out in standing posture. Before doing the tests body height was noted in standing upright position without shoes in centimetres. Body weight was measured in kilograms. Body surface area was calculated from Dubois and Dubois (1916).
Formula:

$$\text{B.S.A. (in sq. metres)} = 0.007\ 184 \times (\text{Wt(in kg's)})^{0.425} \times (\text{Ht(in cm's)})^{0.725}$$

A nose clip was attached to the patient and a clean mouth-piece was inserted into the breathing tube. Two manoeuvres were required from the subject, a forced vital capacity and a maximum voluntary ventilation.

1. **Forced Vital Capacity test procedure:** Subject was explained to take maximum inspiration and then place mouth-piece firmly in mouth and perform maximum expiration and then remove mouth-piece.
2. **Maximum Voluntary Ventilation test procedure:** After rest of 5 minutes subject was asked to breathe as rapidly and deeply as possible in and from the mouth-piece. M.V.V. test was run for 12 seconds.
   Results were taken on the built in printer containing all the patient information and calculated values of all the 14 parameters. This printout was attached along with the proforma.

Precautions taken during the manoeuvres were :-

1. It was made sure that the subject inspires maximally and put in his best efforts during expiration.
2. It was made sure that there was no air leakage around the mouth piece.

Statistical analysis: Mean, standard deviation and standard error of mean and coefficient of variation was calculated and the same represented by tables**.**

Results

Table 1: Classification Of Subjects

Age Groups (years)	Males	Female	Total
50-59	35	35	70
60-69	35	35	70
70-79	20	20	40
80 & above	10	10	20
Total	100	100	200

In the present study, maximum subjects were of age group 50-59years and 60-69 years i.e.70 subjects respectively who were equally divided into males and females respectively.

Table 2: Mean, standard deviation, standard error of mean and coefficient of variation of anthropometric parameters in different age groups of males

Age Group (yrs)	**Age (years)**				**Height (cms)**				**Weight (Kg)**				**BSA (m^2)**			
	Mean	SD	SEM	CV	Mean	SD	SEM	CV	Mean	SD	SEM	CV	Mean	SD	SEM	CV
50-59	54.4	2.92	0.49	5.36	169	5.36	0.90	3.17	66.5	6.43	1.08	9.60	1.76	0.09	0.01	5.11
60-69	64.5	2.69	0.45	4.16	169	6.54	1.10	3.86	68.8	5.93	1.00	8.61	1.78	0.08	0.01	4.49
70-79	73.4	2.76	0.61	0.83	167	4.54	1.01	2.71	65.7	5.19	1.16	7.89	1.74	0.06	0.01	3.44
80 & above	84.1	4.01	1.26	1.49	156	2.93	0.92	1.87	53.8	4.02	1.27	7.47	1.52	0.04	0.01	2.63

In 50-59 years age group males mean age was 54.4 years, mean height was 169cms, mean weight was 66.5 kg and mean BSA was 1.76m^2. In 60-69 years age group males mean age was 64.5 years, mean height was 169cms, mean weight was 68.8 kg and mean BSA was 1.78m^2. In 70-79 years age group males mean age was 73.4 years, mean height was 167cms, mean weight was 65.7 kg and mean BSA was

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1.74m^2. In 80 and above age group males mean age was 84.1 years, mean height was 156cms, mean weight was 53.8 kg and mean BSA was 1.52m^2.

Table 3: Mean, standard deviation. Standard error of mean and coefficient of variation of anthropometric parameters in different age groups of females.

Age Group (yrs)	Age (years)				Height (cms)				Weight (Kg)				BSA (m^2)			
	X	SD	SEM	CV	X	SD	SEM	CV	X	SD	SEM	CV	X	SD	SEM	CV
50-59	54.5	3.18	0.53	5.82	157	4.87	0.82	3.09	63.8	7.0	1.19	11.10	1.64	009	0.01	5.48
60-69	64.1	2.80	0.47	4.36	154	3.91	0.66	3.54	61.8	6.29	1.06	10.16	1.59	0.08	0.01	5.03
70-79	73.3	2.71	0.60	3.69	152	3.04	0.68	2.00	59.9	5.39	1.20	8.90	1.56	0.09	0.02	5.76
80 & above	84.0	3.52	1.11	4.19	147	1.93	0.61	1.31	46.3	3.62	1.14	7.81	1.37	0.04	0.01	2.91

In 50-59 years age group females mean age was 54.5 years, mean height was 157cms, mean weight was 63.8 kg and mean BSA was 1.64m^2. In 60-69 years age group females mean age was 64.1 years, mean height was 154cms, mean weight was 61.8 kg and mean BSA was 1.59m^2. In 70-79 years age group females mean age was 73.3 years, mean height was 152cms, mean weight was 59.9 kg and mean BSA was 1.56m^2. In 80 and above age group females mean age was 84.0 years, mean height was 147cms, mean weight was 46.3 kg and mean BSA was 1.37m^2.

Table 4: Mean, standard deviation, standard error of mean and coefficient of variation of mean and coefficient of variation of lung function parameters in different age groups

Age Group (yrs)	FEV0.5/FVC%				FEV1/FVC%				FEV3/FVC%			
	X	SD	SEM	CV	X	SD	SEM	CV	X	SD	SEM	CV
50-59	66.9	2.31	0.39	3.45	85.6	2.21	0.37	2.58	98.6	1.73	0.29	1.75
60-69	66.6	3.53	0.59	5.29	86.3	2.31	0.39	2.67	98.4	2.04	0.34	2.07
70-79	64.0	6.48	1.44	10.1	85.8	2.83	0.63	3.29	97.3	2.45	0.54	2.51
80 & above	61.3	16.7	5.28	27.2	85.9	7.78	2.46	9.05	96.8	2.09	0.66	2.15

Mean FEV0.5/FVC% was higher in age group 50-59 years, Mean FEV1/FVC% was higher in 80 and above age group, Mean FEV3/FVC% higher in age group 50-59 years.

Table 5: Mean, standard deviation, standard error of mean and coefficient of variation of mean and coefficient of variation of lung function parameters in different age groups of males.

Age Group (yrs)	FVC (litres)				Fev0.5 (litres)				FEV1 (litres)				FEV3 (litres)			
	X	SD	SEM	CV	X	SD	SEM	CV	X	SD	SEM	CV	X	SD	SEM	CV
50-59	2.95	0.43	0.06	14.5	1.96	0.29	0.05	14.7	2.54	0.40	0.07	15.7	2.91	0.41	0.07	14.0
60-69	2.41	0.26	0.04	10.7	1.53	0.24	0.04	15.6	2.02	0.26	0.04	12.8	2.37	0.25	0.04	10.5
70-79	2.05	0.14	0.03	6.8	1.35	0.10	0.02	7.4	1.74	0.12	0.02	6.8	1.99	0.14	0.03	7.00
80 & above	1.52	0.11	0.03	7.2	0.93	0.19	0.06	20.4	1.30	0.11	0.03	8.4	1.47	0.11	0.03	7.48

Mean FVC, Mean Fev0.5, mean FEV1, mean FEV3 was higher in males of age group 50-59 years.

Table 6: Mean, standard deviation, standard error of mean and coefficient of variation of mean and coefficient of variation of lung function parameters in different age groups of males.

Age Group (yrs)	FEV0.5/FVC%				FEV1/FVC%				FEV3/FVC%			
	X	SD	SEM	CV	X	SD	SEM	CV	X	SD	SEM	CV
50-59	66.1	2.95	0.49	4.46	85.7	2.71	0.45	3.16	98.8	1.55	0.26	1.56
60-69	62.5	7.10	1.20	11.3	83.7	4.31	0.73	5.18	98.3	2.39	0.40	2.43
70-79	65.6	3.03	0.67	4.61	84.7	1.94	0.43	2.28	97.2	1.91	0.42	1.96
80 & above	59.5	11.4	3.61	19.1	83.5	5.93	1.88	7.13	96	2.0	0.63	2.08

Mean FEV0.5/FVC%, mean FEV1/FVC%, mean FEV3/FVC% was higher in males of age group 50-59 years age group.

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Table 7: Mean, standard deviation, standard error of mean and coefficient of variation of mean and coefficient of variation of lung function parameters in different age groups of females.

Age Group (yrs)	FEV0.5/FVC%				FEV1/FVC%				FEV3/FVC%				MVV (lts/min)			
	X	SD	SEM	CV	X	SD	SEM	CV	X	SD	SEM	CV	X	SD	SEM	CV
50-59	66.5	2.67	0.31	4.01	85.6	2.40	0.29	2.88	98.7	1.65	0.19	1.67	96.0	15.2	1.88	16.3
60-69	64.6	5.96	0.71	9.22	84.7	3.70	0.45	4.47	98.3	2.22	0.26	2.25	82.9	18.1	2.13	21.9
70-79	64.8	8.22	1.30	12.6	85.3	2.40	0.39	2.90	97.2	2.31	0.36	2.37	66.6	14.1	2.23	21.1
80 & above	60.4	14.3	3.20	23.7	84.7	7.03	1.57	8.29	96.4	2.08	0.46	2.15	41.5	9.06	2.02	21.8

Mean FEV0.5/FVC%, mean FEV1/FVC%, mean FEV3/FVC% was higher in females of age group 50-59 years age group.

Table 8: 't' values of simple Correlation coefficient

Parameter	Age	Height	Weight	BSA	FVC	FEV0.5	FEV1	FEV3	FEV0.5/FVC%	FEV1/FVC%	FEV3/FVC%	MVV
Age												
Height	4.59											
Weight	6.95	9.32										
BSA	6.95	19.64	26.34									
FVC	13.87	13.48	9.30	12.1								
FEV0.5	14.68	10.86	7.92	10.3	36.34							
FEV1	14.22	12.19	8.18	10.8	56.66	43.11						
FEV3	9.47	10.03	6.35	8.95	69.93	23.33	39.99					
FEV0.5/FVC%	2.72	1.27	0.14	0.16	0.11	4.29	1.27	0.071				
FEV1/FVC%	1.13	2.84	2.13	2.10	0.56	2.69	1.42	0.56	15.54			
FEV3/FVC%	2.90	2.41	1.72	2.14	2.16	2.15	2.29	2.72	3.19	3.19		
MVV	14.27	14.68	10.24	13.4	22.99	19.64	19.64	22.99	1.42	1.85	1.56	

Table 9: 'p' values of simple Correlation coefficient

Parameter	Age	Height	Weight	BSA	FVC	FEV0.5	FEV1	FEV3	FEV0.5/FVC%	FEV1/FVC%	FEV3/FVC%	MVV
Age												
Height	<0.001											
Weight	<0.001	<0.001										
BSA	<0.001	<0.0001	<0.0001									
FVC	<0.0001	<0.0001	<0.001	<0.0001								
FEV0.5	<0.0001	<0.0001	<0.001	<0.0001	<0.0001							
FEV1	<0.0001	<0.0001	<0.001	<0.0001	<0.0001	<0.0001						
FEV3	<0.0001	<0.0001	<0.001	<0.0001	<0.001	<0.0001	<0.0001					
FEV0.5/FVC%	<0.01	NS	NS	NS	NS	<0.001	NS	NS	NS			
FEV1/FVC%	NS	<.02	<.05	<.05	NS	<.02	NS	NS	<.01	<.0001		
FEV3/FVC%	<.02	<.05	NS	<.05	<.05	<.05	<.05	<.001	<.05	<.01	<.01	
MVV	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.001	<.001	NS	NS	

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Discussion

The aim of our study is to bridge the gaps of our knowledge in normal ventilatory standards in healthy Punjabi population. The samples studied in the investigation is presumed to represent a cross section of present population of Patiala and a conscious attempt has been made to include subjects form all socio-economic strata since the main purpose of the present investigation has been to follow the trend of the pulmonary parameter with advancing age and to obtain data permitting prediction of normal values for clinical spirometry in elderly Punjabi population.

Vital capacity forms an important part of the lung function. It depends on many factors which may be physiological or pathological such as:

Wang et al. (1971) studied that diaphragmatic shortening contribute 60% of V. to normal breathing in supine position, this value increases with age and is greater in males than in females.

In the present study it is seen that there is significant decrease in FVC with increasing age in both males and females i.e. it has a negative correlation with age in both the sexes.[5]

The regression equation observed in the present study in malegroup to predict FVC has partial regression coefficient for age (-0.071).

Partial regression coefficient for height was 0.093.

The regression equation in present study for females to predict FVC has partial regression coefficient for height (0.019) and partial regression coefficient for weight (0.013). Partial regression coefficient for total study to predict FVC has partial regression coefficient for age (-0.027) and for height (0.046).

Knudson R.J. et al. (1983) found out that although FVC and FEV1 increase with growth and development and subsequently decrease with senensce. In adulthood one enters into the phase of decline, measured parameters decreasing with age as shown by negative sign of age co-efficient.[6]

These findings are consistent with our studies.

Wu H.D. et al (1990) observed significant fall in vital capacity.[7]

Age related negative correlation were noted in vital capacity in both the sexes. These findings are in concurrent with our studies.

Brandli O. et al. (1996) showed that most lung function variables are non linear with age and showed an increase in early adulthood and an accelerated decline thereafter.[8]

In the present study it is seen that FEV0.5 shows a significant decrease in both males and female with increasing age i.e. there is a negative correlation with age.

The regression equation observed in the present study in male subjects to predict FEVO.5 has partial regression coefficient for age (- 0.038). Partial regression coefficient for height (0.036) and partial regression cocfficient for weight (0.026). The regression equation observed in present study for female subjects to predict FEV 0.5 has partial regression coefficient for age (-0.022), partial regression coefficient for height (0.0310) and partial regression coefficient for weight

(0.0024). The regression equation observed in the present study for total study group has partial regression coefficient for age (-0.020), for height (0.031) and weight (0.0024.

Similar findings in FEV 0.5 has been seen in studies of Knudson R.J. et al. (1983)[6], Yang S.C. (1993)[9].

In the present study it is seen that FEV0.5/FVC% in case of males it negatively correlated with age and in females it is nonsignificantly correlated with age. These findings go with the findings of Crapo R.O. et al (1981)[10], Knudson et al. (1976)[6].

FEVI is the amount of vital capacity that is expired during the first second, normally 80% of total vital capacity is expired out in the first second. This measurement is much more sensitive index of the obstructive disease than is provided by the vital capacity itself. In bronchial asthma only 30% of the vital capacity may be expired during the first second. It so helps in differentiating the restrictive lung disease from the obstructive type. In the former although the vital capacity is gravely decreased yet he proportion of vital capacity expired in the first second is normal.

In the present study it is seen that there is a significant decrease of FEVI with increasing age in males and females i.c. it has a negative correlation with age.

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The partial regression coefficient observed in present study for predicting FEV1 in male subjects for age (-0.057), partial regression coefficient for height (0.049) and partial regression coefficient for weight (0.034). The partial regression coefficients as observed in present study for female subjects for age (-0.0366), partial regression coefficient for height (0.0405) and partial regression coefficient for weight (-0.005). The partial regression coefficient as observed in present study for total study for age (-0.0377), for weight (-0.005) and for height (0.0425).

Our findings of FEV1 tally with the findings of Knudson R.J. et al. (1976)[6], Crapo. R.O. (1981).[10]

In the present study we see that FEV I/FVC% is nonsignificantly correlated with age in both the sexes. Similar studies are reported by Knudson R.J. ct al. (1976)[6], Crapo R.O. et al. (1981)[10], Chatterjee S. et al. (1988)[11].

In the present study it is seen that FEV3 decreases with increasing age i.e. it has a negative correlation with age.

The partial regression coefficient observed in present study for predicting FEV3 in male subjects for age (-0.058), partial regression coefficient for height (0.058) and partial regression coefficient for weight (0.043). The partial regression coefficients as observed in present study for female subjects for age (-0.023), partial regression coefficient for BSA (0.0279) as seen from table d. The partial regression coefficient as observed in present study for total study for age (-0.027), for height (0.045).

A study goes in concurrent with the study of Crapo. R.O.et al. (1981),[10] Yang. C.S.(1993)[9].

In the present study it seen that FEV3/FVC% is negatively correlated with age in male and total study group. It is nonsignificantly correlated with age in the case of females. These findings tally with the studies of Crapo R.O. et al. (1981)[10], Knudson R.J.et al. (1983).[6]

Conclusion

The study concluded that Mean FEV0.5/FVC% was higher in age group 50-59 years, Mean FEV3/FVC% higher in age group 50-59 years as compared to 60 and above age group. Mean FEV1/FVC% was higher in 80 and above age group whereas less in age group below 80 years. In males and females Mean FVC, Mean Fev0.5, mean FEV1, mean FEV3 was higher in age group 50-59 years as compared to 60 and above age group.

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