PULMONARY FUNCTION TESTS IN YOUNG HEALTHY SUBJECTS OF NORTH INDIA

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Abstract :

Study Objectives : *The diagnosis of disease done by skiagram can be substantiated by pulmonary function tests. Substantial data of Indians on PFTs is not available. The present study therefore has been planned on young healthy north Indians.*

Setting : *119 males and 49 female medical students of North India.*

Measurements : *PFT's, T.V. FEV1, FVC, FER and PEFR were measured. P<0.05 was considered as significant.*

Results : *In North Indian males, mean T. V was 437.56 $\pm$ 65.83 ml, FEV1 3.26 $\pm$ 041 L, FVC 3.82 $\pm$ 0.48 L, FER 85.09 $\pm$ 2.42% and PEFR was 495.42 $\pm$ 101.82 L / min. In North Indian females. average T. V was 386.12 $\pm$ 37.90 ml, FEV1 2.39 $\pm$ 0.38 L, FVC 2.79 $\pm$ 0.43 L, FER 85.38 $\pm$ 257% and PEFR was 307.12 $\pm$ 75.74 L / min.*

Conclusions: *Males in comparison to females had more value of PFTs. All the PFTs showed positive correlation with Height, Weight and Surface area except Tidal Volume and FER.*

Key Words : *Pulmonary Function Test (PFT), Height, Chest Circumference, Body Mass Index (BMI), Surface Area.*

Abbreviations : *T.V. Tidal volume, FEV1 - Forced expiratory volume in first second, FVC - Forced vital capacity, FER - Forced expiratory ratio, PEFR - Peak expiratory flow rate.*

Introduction :

The present study has been undertaken as substantial data on pulmonary function tests are not available in the North Indian subjects, so this study would enable the future workers to have a back ground study for comparison in North Indian Subjects.

Mean vital capacity values were higher in western reports than the Indian studies. Maximum values seem to have been attained by 19 years and after that they stay nearly constant up to the age of 40 [4]. Women had much lower values than men [7].

American Thoracic Society published in its statements [1, 2, 3] in 1979, 1987 and 1991 for standardization of Spirometry and provided various guidelines for the instruments which were used for lung function tests.

The pulmonary function among Indians of both sexes showed the expected norms for the forced vital capacity, maximal breathing capacity and expiratory peak flow for Indians of various age groups [8]. In addition to age, sex and height. other factors such as ethnic origin, physical activity, environmental condition and tobacco smoking can affect normal values of ventilatory function [5] There were wide

variations in pulmonary function values from one individual to another depending upon age and height of the subjects (5).

The recordings of pulmonary function tests (spirometry and maximal expiratory flow rates showed that the correlations of FVC and FEV1 were, in general,highest with height followed by weight and age (9). A study of the changes in lung function in men of different age groups concluded that remarkable significant changes take place in lung function after the age of forty years (8). The difference between British and the Indian data was not due to change in thoracic size but it was genetic rather than environmental factors which are responsible for the ethnic difference in various comparative studies. It was also noted that the indices representing airway caliber do not differ between the ethnic groups (6).

The study of healthy, nonsmoking Caucasian, Chinese and Indian subjects suggested that Indians had lower total Lung Capacity and Vital Capacity than the two other groups. This was related to longer chests in the other two groups but it was also opined that longer chest was not the sole factor as such responsible for higher values. It may be due to increased number of alveoli in other two groups due to ethnic variation (6).

Material and Methods :

The present study was conducted on 168 medical students of G.S. V. M. Medical College, Kanpur,U. P. India comprising of 119 male & 49 female students of age group ranging from 18-27 yrs. and 18-23 yrs. respectively. All the students were residents of north India.

Prior to the study, the health status of the students was determined and those who were without any signs and symptoms of respiratory disorder as determined by the history and clinical examination, were included in the study.

The purpose of the test and methods to be used were explained to the subjects and the test was then performed, in sitting posture.

The parameters recorded were TV by Benedict Roth spirometer, FEV1, FVC, FER and PEFR by digital microspirometer.

The measurements recorded in all students were classified according to Height, Chest Circumference, Body mass Index and Surface Area. Then both male and female students were divided in 3 groups as H_1, H_2 and H_3. Male H_1- 150-160 cms, H_2 -161 -170 cms, H_3 -> 171 cms. Female H_1-140-150 cms, H2-151-160 cms, and H_3- >161 cms.

The male and female students were divided into C1, C2 and C3 groups according to their chest circumference as C1-<80 cms, C2- 81-90 cms and C3->91 cms.

The body mass index (BMI) of male ad female students was determined by Quetelet's index. On the basis of reference tables for BMI by FAO/WHO/UNO Report (9) the students were classified into three groups. Males : B1-22 , B2-20.1-15 (<20 & 25-29) and B3-Obese -30 or > 30 and Females B1- Desirable Average - 20.8, B_2- Desirable Range- 18.7-23. 8 (<18->23.8-27) and B_3- Obese- 28.5 or >28.5.

The surface area of male and female subjects were measured by using DUBOIS

BODY SURFACE CHART and were divided in to 3 groups- S_1, S_2 & S_3 Male S_1-1.40-1.60 m² S_2- 1.61-1.80m² and S_3->1.81 m² and Female as S1-1.20-1.40 m², S_2-1.41-1.60m² and S_3->1.61 m2.

Statistical Analysis : By Student's 't' test and $p < 0.05$ was considered as significant.

Results :

The age of male medical students ranged between 18- 27 years with an average of 20.74 +1.83 years. The various average physical parameters were as follows: Height 171.01± 6.09 cms; Chest circumference 83.62±6.40 cms; Surface area 1. 68+0.12m2 and Body mass index 20. 13±2.93.

The female subjects were between 18-23 years of age with an average of 19.15 ± 1.35 years. The various mean physical parameters of this group were as follows: Height 158.28±4.88 cms; Chest circumference 82.

55±7.16 cms; Surface area 1.50±0.1m² and Body mass index 20.39±3.21.

The variations in T.V., FEV_1, and FVC were found between male and female subjects. The average T.V. in male subjects was 437.56±65.83 ml as compared to 386.12± 37.90ml in female. The FEV_1 averaged to 3.26±0.41 L in males whereas it was 2.39±0.381 in females. The average FVC was 3.82±0.48 L in males and showed relatively lower value of 2.79±0.43 L in females. Therefore T. V., FEV_1 and FVC was found to be significantly lower in females ($p < 0.05$).

Since FER% is a ratio, it did not alter in males and females and remain to an average of 85.09±2.42% and 85.38±2.57% in males and female subjects respectively.

The PEFR showed the significant difference between the two sexes ($p < 0.05$) and was to an average of 495.42 + 101.82 L/min. in males and 307.12 ± 75.74 L/min. in females.

TABLE-1

Mean Height and Mean Respiratory Parameters in Male Subjects.

HEIGHT GROUPS	MEAN HEIGHT (cms)	MEAN T.V.(ml)	MEAN FEVI(L)	MEAN FVC(L)	MEAN FER(%)	MEAN PEFR (L/min)
H1 (n=8) (150-160 cms.)	158.25 ± 1.909	437.5 5 ± 144.32	3.051 ± 0.614	3.559 ± 0.727	85.375 ± 12.446	504.5 ± 38.09
RANGE	156-160	400-500	2.12-3.86	2.57.453	82.89	445-657
H2 (n=44) (161-70cms)	166.75 ± 2.92	438.86 ± 66.41	3.11 ± 0.31	3.66 ± 0.38	85 ± 2.33	473.66 ± 97.56
RANGE	161-170	250-550	2.50-3.54	2.61-4.61	80-89	230-666
113 (n=67) (>171 cms)	175.34 ± 3.08	436.71 ± 68.29	3.37 ± 0.41	3.95 ± 0.48	85.11 ± 2.31	508.64 ± 108.07
RANGE	171-184	250-600	2.29-4.36	2.76-5.03	79-90	297-706

TABLE-2

Mean Height and Mean Respiratory Parameters in Female Subjects.

HEIGHT GROUPS	MEAN HEIGHT (cms)	MEAN T.V.(ml)	MEAN FEVI(L)	MEAN FVC(L)	MEAN FER(%)	MEAN PEFR (L/min)
H1 (n=4)	149.5	375	2.02	2.418	81.25	260.25
(140-150 cms.)	± 1.00	± 50.00	± 0.282	± 0.371	± 1.893	± 81.332
RANGE	148-150	300-400	1.72-2.27	1.98-2.27	82-86	180-344
H2 (n=44)	156.66	387.33	2.38	2.81	85.56	296.36
(151-160cms.)	± 2.68	± 40.93	± 0.38	± 0.45	± 2.83	± 71.43
RANGE	152-160	350-500	1.51-3.02	1.85-3.45	79-89	126-438
H3 (n=67)	163.86	386.66	2.50	2.91	85.6	334.46
(> 161 cms.)	± 2.36	± 29.68	± 0.35	± 0.43	± 1.95	± 76.78
RANGE	161-167	350-450	1.87-2.97	2.16-3.50	82-89	210-449

TABLE - 3

Mean Chest Circumference (C.C.) and Respiratory Parameters in Male Subjects.

CHEST CIRCUMFERENCE GROUPS	MEAN C.C. (cms)	MEAN T.V.(ml)	MEAN FEVI(L)	MEAN FVC(L)	MEAN FER(%)	MEAN PEFR (L/min)
C1 (n=43)	77.06	425.81	3.21	3.75	85.09	484.72
(< 80 cms.)	± 2.32	± 66.80	± 0.40	± 0.49	± 2.46	± 100.10
RANGE	72-80	250-600	2.22-4.09	2.66-5.03	79-89	308-670
C2 (n=64)	85.68	441.87	3.30	3.84	85.23	500.82
(81-90cms.)	± 2.69	± 66.01	± 0.43	± 0.49	± 2.37	± 101.71
RANGE	81-90	250-600	2.12-4.36	2.57-4,90	81-90	230-670
C3 (n=12)	96.08	440.00	3.30	3.89	84.33	488.66
(≥91 cms.)	± 3.98	± 58.15	± 0.33	± 0.45	± 2.60	± 128.75
RANGE	91-102	300-500	2.63-3.83	2.99-4.59	81-89	296-406

TABLE-4

Mean Chest Circumference (C.C.) and Respiratory Parameters in Female Subjects.

CHEST CIRCUMFER ENCE GROUPS	MEAN C.C. (cms)	MEAN T.V.(ml)	MEAN FEVI(L)	MEAN FVC(L)	MEAN FER(%)	MEAN PEFR (L/min)
C1 (n=23) (≤ 80 cms.)	77.26 ± 2.61	391.30 ± 38.88	2.43 ± 0.35	2.82 ± 0.139	85.65 ± 2.56	321.17 ± 75.27
RANGE	72-80	350-450	1.87-2.97	1.98-3.50	79-89	202-449
C2 (n=21) (81-90cms.)	84.76 ± 2.79	379.52 ± 40.05	2.41 ± 0.43	2.81 ± 0.50	85.42 ± 2.69	289.57 ± 78.25
RANGE	81-90	300-500	1.51-3.02	1.85-3.45	81-89	126-411
C3 (n=5) (≥91 cms.)	98.00 ± 7.34	390.00 ± 22.36	2.15 ± 0.20	2.55 ± 0.22	84.00 ± 2.0	316.2 ± 64.92
RANGE	92-107	350-400	1.96-2.40	2.31-2.81	81-86	213-374

The careful statistical evaluation shows that these lung functions were not showing appreciable difference between the three subgroups and hence the chest circumference does not seem to have detectable influence on lung function ($p > 0.05$ between all data).

TABLE - 5

Mean Surface area and Mean Respiratory Parameters in Male Subjects.

SURFACE AREA GROUPS	MEAN SURFACE AREA (M²)	MEAN T.V.(ml)	MEAN FEVI(L)	MEAN FVC(L)	MEAN FER(%)	MEAN PEFR (L/min)
S1 (n=41) (1.40-1.60m²)	1.35 ± 0.05	396.25 ± 10.60	2.23 ± 0.4	2.57 ± 0.42	85.87 ± 2.74	300. 12 ± 83.61
RANGE	1.26-1.40	370-400	1.51-2.59	1.85-3.01	81-89	160-390
S2 (n=57) (1.61-1.80m²)	1.49 ± 0.05	382.81 ± 45.09	2.42 ± 0.40	2.82 ± 0.45	85.40 ± 2.69	304.31 ± 76.86
RANGE	1.42-1.60	350-500	1.67-3.02	1.99-350	81-89	126-449
S3 (n=21) (≥1.81m²)	1.67 ± 0.04	388.88 ± 22.04	2.42 ± 0.28	2.86 ± 0.133	84.88 ± 2.08	323.44 ± 70.97
RANGE	1.62-1.76	350-400	1.96-2.79	2.31-3.30	82-89	213-374

TABLE-6

Mean Surface Area and Mean Respiratory Parameters in Female Subjects.

SURFACE AREA GROUPS	MEAN SURFACE AREA (M²)	MEAN T.V.(ml)	MEAN FEVI(L)	MEAN FVC(L)	MEAN FER(%)	MEAN PEFR (L/min)
S1 (n=8)	1.55	433.17	3.10	3.62	85.29	463.87
(1.20-1.40m²)	± 0.05	± 63.93	± 0.36	± 0.42	± 2.32	± 105.62
RANGE	1.40-1.60	250-550	2.29-3.88	2.76-4.53	81-89	230-652
S2 (n=32)	1.71	438.77	3.28	33.83	85.22	491.21
(1.41-1.60m²)	± 0.05	± 74.81	± 0.43	± 0.51	± 2.46	± 94.66
RANGE	1.62-1.80	250-600	2.12-4.11	2.54-5.03	81-90	247-670
S3 (n=21)	1.88	442.85	3.54	4.15	84.80	556.71
(≥1.61m²)	± 0.06	± 40.61	± 0.32	± 0.34	± 2.35	± 88.76
RANGE	1.82-2.06	350-500	2.80-4.11	3.31-4.67	81-89	423-706

TABLE - 7

Mean Body Mass Index and Mean Respiratory Parameters in Male Subjects.

BODY MASS INDEX GROUPS	MEAN BMI	MEAN T.V.(ml)	MEAN FEVI(L)	MEAN FVC(L)	MEAN FER(%)	MEAN PEFR (L/min)
B1 (n=13)	22.15	446.92	3.33	3.89	85.07	477.46
(22.0)	± 0.28	± 72.15	± 0.46	± 0.54	± 2.49	± 124.89
RANGE	22.0-.22.8	250-500	2.61-4.11	2.92-4.67	82-89	. 297-673
B2 (n=105)(20.1-25)/	19.75	416.76	3.25	33. 7 9	85.20	496.97
<20.1-25.0-30.0)	± 270	± 65.50	± 0.41	± 0.47	± 2.39	± 99.36
RANGE	15.7-27.5	250-600	2.12-4.11	2.57-5.03	81-90	230-706
B3 (n=1) (>30.0)	33.7	400	3.48	4.10	84	567
RANGE	-	-	-	-	-	-

TABLE - 8

Mean Body Mass Index (BMI) and Mean Respiratory Parameters in Female Subjects.

BODY MASS INDEX GROUPS	MEAN BMI	MEAN T.V.(ml)	MEAN FEVI(L)	MEAN FVC(L)	MEAN FER(%)	MEAN PEFR (L/min)
B1 (n=10) (20.8)	20.2 ± 0.27	360 ± 31.62	2.33 ± 0.45	2.75 ± 0.49	84.8 ± 3.15	289.7 ± 76.18
RANGE	19.8-20.6	350-400	1.67-2.91	1.99-3.44	79-89	126-377
B2(n-37)18.7-23.8) <18.7->2.3.8-28.5)	19.91 ± 2.81	392.43 ± 37.74	2.41 ± 0.37	2.81 ± 0.42	85.62 ± 2.45	317.29 ± 75.19
RANGE	15.6-26.0	300-500	1.51-3.02	1.85-3.50	81-89	160-449
B3 (n=2) (>28.5)	30.25 ± 2.47	400 ± 0.00	2.22 ± 0.17	2.63 ± 0.24	85 ± 0.00	256 ± 60.81
RANGE	28.50-32.00	400	2.10-2.34	2.46-2.81	85	213-299

Discussion :

In the present work, we observed the significant difference in the T.V. recorded in male and female subjects. The lower values were observed in female subjects. It was also observed that T.V. neither had any correlation with height and surface area nor with Chest circumference and BMI in either sex. Thus, it seems that the sex difference is the only variable influencing the T.V. The observations in T.V. therefore, could not be compared with other findings due to paucity in literature.

The weight did not correlate highly with any of the subdivisions of lung volumes and showed a significant positive correlation only with FVC in both sexes. Furthermore, the exploration of the results suggested that the BMI and Chest circumference did not have positive correlation with the lung functions.

The most important factors showing positive influence on the lung functions in the present study in different subgroups have been found to be height and surface area. Numerous authors have endeavored to show the similar relationship with FEV_1 and FVC.

No difference in FVC and PEFR between males and females is reported(5). In contrast to this finding. we have found significant difference in these data between male and female subjects. We have also found the linear relationship between PEFR and surface area in different subgroups whereas some authors have shown the linear relationship between height, weight, age and chest circumference and PEFR. In our study, we have eliminated the influence of age by selecting the subjects within a narrow range of age group. Our result in Various subgroups suggests that the relationship of surface area with PEFR includes both the components of height and weight and hence the results seem to be in close with those of other authors.

In our Study, no relationship of BMI could be established with different lung functions in males and females and results could not be compared as only scarce reports are available. Further work in this regards is required to establish any such relationship.

Conclusions :

The following conclusions have been derived :

1. The mean T.V., FEV_1. FVC, FER and PEFR were 437.56 $\pm$ 65.83ml, 3.26 $\pm$ 0.41 L 3.82 + 0.48 L, 85.09 $\pm$ 2.42% and 495.42 $\pm$ 101.82 L/min respectively in North Indian male subjects, between mean age of 18-27 years.

2. The average T.V., FEV1, FVC, FER and PEFR were 386.12 + 37.90ml, 13910.38 L, 2.79 + 0.43 L, 85.38 $\pm$ 2.57% and 307.12 $\pm$ 75.74 L/min. respectively in North Indian females between mean age of' 19-23 years.

3. A significant difference ($p < 0.05$) has been found between male and female subjects in aforementioned respiratory data.

4. The FEV 1, FVC and PEFR shows positive correlation with height, weight and surface area except T.V. and F.E.R.

5. The Chest circumference and Body mass index do not seem to have significant influence on the pulmonary function tests.

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