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Correlation Of Body Composition With Dynamic Lung Function.

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Abstract:*Lung volumes that depend upon the rate at which air flows out of the lungs are termed dynamic lung volume. Dynamic lung volumes include Forced Vital Capacity(FVC), forced Expiratory Volume in 1 Second(FEV_1)& FEV_1/FVC ratio. These lung parameters are very commonly used in clinical practice to diagnose various obstructive and restrictive diseases. For long, Body Mass Index & Waist Hip Ratio are being used to assess the obesity and their effect on lung function. But BMI has the limitation of not distinguishing between fat and muscle mass. So this study was undertaken to study that which body parameter is responsible for improved or worsened lung function.150 healthy medical students(85 males and 65 females) with age group 18-24 years were included in the study. Their body composition was studied using 'Bioelectric Impedance' method. Each dynamic lung function was correlated with body fat percentage (BF%), fat free mass(FFM), fat free mass index(FFMI), BMI & waist hip ratio. FFM showed highest as well as significant correlation with FVC, FEV_1& FEV_1/FVC.BF% has insignificant correlation with all dynamic lung function. BMI & W/H ratio, have lower or insignificant correlation with dynamic lung functions, than FFM & FFMI.*

Keywords:*Dynamic lung volumes, Forced vital capacity, Forced expiratory volume, Body mass index, Waist hip ratio, Body fat percentage, Fat free mass, Fat free mass index.*

I. Introduction:

The belief that weight shows little or no correlation with pulmonary function measurements[1] has been abandoned and currently Body Mass Index(BMI) is the more popular tool in scientific works. Various studies show the association of elevated BMI with impaired Pulmonary Function Parameters[2].But BMI has important limitation of not distinguishing between Body Fat & Body Fat Free Mass (FFM)[3]. Fat free mass includes muscle, bone, water & blood. Fat percentage is independent of stature and FFM resembles body mass in being correlated with stature. The association is reduced or eliminated by expressing FFM as Fat Free Mass Index[3] (FFMI=FFM/Stature^2).Most of the earlier studies regarding the effect of obesity on respiratory function[2, 4]have been done relating BMI but not FFM or FFMI. Hence, this pioneering study is undertaken to assess if correlation of PFT exists with body fat percentage, FFM, FFMI and whether it is possible to establish them as lung reference variable.

II. Methods

The study was conducted on 150 medical students (85 males, 65 females) aged between 18-24years. All the volunteers were apparently healthy. The experimental protocol was explained to all student volunteers and written informed consent was obtained. The Institutional Ethical Committee was obtained to conduct the study, conducted between October, 2010 to September, 2012. The study was conducted after a minimum of 2hours of light breakfast. To avoid circadian variation[5] all study were conducted between 10am to 12noon.

All anthropometric measurements such as, age sex height and weight were recorded. Body weight was recorded in kilograms on empty bladder and before lunch wearing light weight clothing and bare foot with "Prestige Digital Weighing Scale". Standing height was recorded using "stadiometer" to the nearest 0.1cm. BMI was calculated using the following formula,

$$\text{BMI(Quetlet's Index)=Weight (in kg)/\{Height(in meters)\}}^2$$

The body fat percentage was measured by "Bioelectric Impedance" analysis technique using 'OMRON Body Fat Monitor (HBF-306)'. From BF%, FFM (100-Fat% × body weight) and FFMI (FFM/Ht^2) was calculated.

Pulmonary Function were recorded on a window based "FlowhandyZaN 100 USB &ZaN. GPI. 3xx",Germany. Pulmonary function was recorded according to American Thoracic Society Guidelines[6].

III. Results

The results were analysed using software 'GraphPad Prism version 6.0'.

Table 1Anthropometric Parameters (Mean ± SD)

	MALES(n = 85)	FEMALES(n=65)	p-VALUE
HEIGHT(In cm)	165.55 ± 5.8608	154.1158 ± 6.109	<0.0001
WEIGHT(In kg)	64.706 ± 11.7838	56.8153 ± 11.387	<0.0001
WAIST CIR(In inches)	31.846 ± 2.9081	30.118 ± 4.147	0.0027
HIP CIR.(In inches)	36.984 ± 2.629	35.781 ± 3.853	0.0222
WAIST/HIP RATIO	0.8606 ± 0.04819	0.841 ± 0.061	0.0196
BMI (kg /m^2)	23.5108 ± 3.7207	23.9015 ± 4.4875	0.5556(ns)
BF%	22.946 ± 5.1178	31.14 ± 6.125	<0.0001
FFM (kg)	49.4012 ± 6.7735	38.481 ± 4.816	<0.0001
FFMI (kg /m^2)	17.984 ± 1.9372	16.1866 ± 1.657	<0.0001

(p< 0.05 are significant)

On 'Unpaired t-test' the anthropometric parameters were significantly different for males and females except BMI. The BMI is within normal range for both males and females. But the fat percentage is 22.9% in males which is more than the normal range of 8-19% and in females the average value is 31.14% which is within normal range of 21-33%.

Table 2 Dynamic Lung Functions

	MALES	FEMALES	P - VALUE
FVCex (In litres)	4.023804 ± 0.529	2.991846 ± 0.421	< 0.0001
FEV$_1$ (In litres)	3.586522 ± 0.433	2.760462 ± 0.381	< 0.0001
FEV$_1$/FVC	89.44565 ± 5.669	92.41538 ± 5.276	0.0012

(p< 0.05 are significant)

The dynamic lung values are not similar for males and females. 'Unpaired t-test' showed significant difference between male and female flow rates. So, the male and female lung function was compared separately with their respective body composition to avoid gender related variations.

TABLE 3 Correlation Coefficients of Dynamic Lung Functions (Males)

	BMI	BF%	FFM	FFMI	W/H
FVCex	**0.2114**	0.08631	**0.5570**	**0.2942**	**0.2496**
FEV$_1$	0.07791	0.02710	**0.4085**	0.1342	0.1382
FEV$_1$/FVC	**-0.3125**	-0.1695	**0.3798**	**0.3595**	**-0.2562**

(All the figures in bold letters are Significant, i.e. p < 0.05)

TABLE 3 shows the various correlation coefficients of FVC, FEV$_1$ and FEV$_1$/FVC with the body composition parameters. The 'Pearson r' values show highest values for FVC and FEV$_1$ with FFM. FEV$_1$/FVC has highest positive significant correlation with FFM. BF% shows insignificant correlation with all dynamic lung functions.

TABLE 4Correlation Coefficients Of Dynamic Lung Functions (Females)

	BMI	BF%	FFM	FFMI	W/H
FVCex	0.03034	0.0419	**0.4516**	0.06523	0.09032
FEV$_1$	0.009488	0.0265	**0.4286**	0.04322	0.01644
FEV$_1$/FVC	-0.07442	-0.0633	0.1041	-0.0750	-0.2073

(All the figures in bold letters are Significant, i.e.p<0.05)

Only the FVCex and FEV$_1$have significant as well as positive correlation with FFM.

IV. Discussion

In male subjects**,** the 'Pearson r' values show highest values for FVC and FEV_1 with FFM. FEV_1/FVC also has highest positive significant correlation with FFM. BF% shows insignificant correlation with all dynamic lung functions.Our study agrees with the findings of Young et al, 2003[7] and Ceylan and co-workers,2008[8] that is FVC and FEV_1 shows highest significant correlation with FFM followed by FFMI. Helena and co-workers, 2001[9], Chen Y et al, 1993[10] and Young et al, 2003[7]found negative correlation of BMI with both FVC and FEV_1.In female subjects, FVCex and FEV_1 have only significant and positive correlation with FFM. Our study does not agree with the findings of Young et al, 2003[7] where BMI and BF% were found to improve FVC and FEV_1 in women. But it agrees with the findings of Helena and co-workers, 2001[9].FEV_1/ FVC does not have any significant correlation with any of the body composition parameter which agrees with the findings by Muralidhara and Ramesh, 2007[8].

V. Conclusion

The Dynamic Lung Function parameters:

- (FVC and FEV_1) have highest and significant correlation with FFM and FFMI in both males and females.
- FEV_1/ FVC have highest positive & significant relationship with FFM followed by FFMI in males. In Females, FEV_1/ FVC has insignificant relationship with all body composition parameters.

The effect of allowing for body composition is useful for those people who have more or less fat and/or muscle compared with average. BMI, because it combines information on fat and muscle, does not provide similar information[11]. So, it provides limited information and cannot always be used as a reference for dynamic lung functions.Also making allowances for body composition can improve the accuracy and biological relevance of reference equation for lung function[12]. The use of anthropometric and skinfold measurements has been criticised as being unreliable and inaccurate; they are unable to adequately assess adiposity and are liable to operator bias[13].Limited usefulness of BMI should be taken into consideration and FFM & FFMI should be used as reference variable. Measurement of FFM by 'Bioelectrical Impedance' method is inexpensive, reliable, simple, safe and non-invasive technique for use in lung function laboratories[14].

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