



Study and Analysis of Respiratory Parameters With Respect to Body-Mass-Index

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Abstract

In India, in recent decades there has been a simultaneous increase in the incidence of obesity and pulmonary disorders. This study has therefore been carried out to reassess the pulmonary function values in normal and obese Indian population and to check their variation in various pulmonary disorders. Forced spirometry is one of the ways, which provides a written record of FVC, FEV1 and FEV1/FVC. In addition to these parameters, BMI values are included to detect the potential severity of obstructive lung disorders.

Keywords: BMI, FEV1, Forced Spirometry, FVC, Obesity, Pulmonary Disorder.

1. Introduction

Respiration is the biochemical process in which the cells of an organism obtain energy by combining oxygen and glucose, resulting in the release of carbon dioxide, water, and Adenosine-Tri-Phosphate (ATP), the currency of energy in cells.

Respiratory system is a biological system consisting of specific organs and structures used for the process of respiration in an organism. It is involved in the intake and exchange of oxygen and carbon-di-oxide between an organism and the environment. In air-breathing vertebrates like human beings, respiration takes place in the respiratory organs called *Lungs*. The passage of air into the lungs to supply the body with oxygen is known as *inhalation*, and the passage of air out of the lungs to expel carbon-di-oxide is known as *exhalation*; this process is collectively called *breathing or ventilation*. Molecules of oxygen and carbon-di-oxide are passively exchanged, by

diffusion, between the gaseous external environment and the blood. This exchange process occurs in the *alveoli air-sacs* in the lungs.

Lung diseases are very common among people. Obesity is another major health problem which seems to be increasing all around the world. It can be defined as excess adipose tissue.

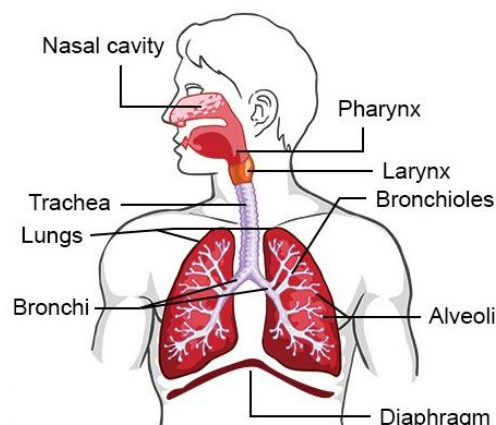


Figure 1: Pathway of Air

It is this, not weight which is associated with the comorbid conditions. Expert panels from both the

National Institutes of Health and the World Health Organization have developed such cut points, which define overweight as a Body-Mass-Index (BMI) of 25.0 to 29.9 kg/m².

$$BMI = \text{weight [in kg]} / \text{height [in m]}^2$$

In recent decades there has been a simultaneous increase in the incidence of obesity and obstructive diseases.

Obesity with respect to BMI was categorized into the following three grades, namely:

- Grade I or Mild obesity as a BMI of 30 to 34.9 kg/m²
- Grade II or More Severe obesity as a BMI of 35 to 39.9 kg/m²
- Grade III or Extreme obesity as a BMI of 40 kg/m²

Looking at all these factors, a review of pulmonary function test in Indian population is needed. Our aim is to find the values for pulmonary function test parameters like

- Forced Vital Capacity (FVC)
- Forced Expiratory Volume in first second (FEV1)
- FEV1/FVC ratio

and comparing the obtained numerals with the predicted values.

2. Methodology

Lung disorders can be identified by using Pulmonary Function Tests (PFTs), which measure lung capacity to diagnose any lung ailment.

Spirometry (a PFT) is a technique used to measure air flow and lung volumes. The equipment used here is PC-Based Spirometer.

This is a cross sectional, comparative study in which, we diagnosed 28 subjects using a computerized spirometer. Pulmonary function tests were also carried out on patients having respiratory disorders. Hence, we collected data of 15 normal subjects, 5 obese subjects, 6 subjects having Asthma and 2 subjects having COPD. All subjects selected were in the age group of 20-30 yrs.

Table 1: Comparison of physical parameters of normal subjects and those suffering from obstructive lung disease

Physical Parameters	Normal (mean)	Asthma (mean)	COPD (mean)
Age (in years)	23	25	25
Height (in cm)	168.15	167.5	156
Weight (in Kg)	54	51.6	55.8

From above table it is apparent that the difference in age, height and weight in all the three groups is insignificant. Thus all three groups match closely for these three physical parameters.

PROCEDURE OF SPIROMETRY

1. Detailed clinical history of the subjects was taken.
2. The subject was made to sit in front of the electronic spirometer on the table with the mouth piece of spirometer at the level of his lips.
3. The subject was asked to take full and unhurried inspiration, then close lips around the mouth piece and expire forcefully in the mouth piece.

Parameters, FVC, FEV1 and ratio of FEV1/FVC were considered, because they are standard indices for assessing and quantifying airflow limitation. These help in diagnosing obstructive lung disorders and BMI determines the potential severity. Forced Expiratory Volume in 1 sec (FEV1) and Forced Vital Capacity (FVC), tend to decrease with increasing BMI. However, the effect is small, and both FEV1 and FVC are usually within the normal range for obese adults. The ratio FEV1-to-FVC is usually well preserved or increased even in morbid obesity, indicating that both FEV1 and FVC are affected to the same extent. This finding implies that the major effect of obesity is on lung volumes, with no direct effect on airway obstruction.

3. Results

Following observations were made from the study of pulmonary function tests in 28 subjects.

Table 2: Female Normal Subjects

Serial number	FVC	FEV1	FEV1/FVC	BMI
1	1.98	1.26	0.635	16.66
2	1.86	1.63	0.873	16.86
3	1.85	1.38	0.745	18.75
4	2.87	1.85	0.643	25.00
5	2.36	1.76	0.745	16.06
6	1.84	1.48	0.804	18.07
7	1.98	1.45	0.732	16.06
8	2.01	1.78	0.885	25.77

Table 3: Male Normal Subjects

Serial number	FVC	FEV1	FEV1/FVC	BMI
1	2.92	2.26	0.773	21.07
2	3.62	2.95	0.814	25.39
3	2.73	2.84	1.040	24.22
4	3.91	3.08	0.787	22.65
5	2.68	1.85	0.690	26.56
6	3.33	2.73	0.819	26.98
7	2.96	1.99	0.672	19.40
8	3.77	2.71	0.718	17.72
9	3.77	2.70	0.716	18.12
10	3.94	2.51	0.637	22.53
11	3.78	2.60	0.687	24.59
12	4.74	3.27	0.689	13.59
Average	3.513	2.624	0.746	21.90

Table 4: Male Asthma Subjects

Serial number	FVC	FEV1	FEV1/FVC	BMI
1	4.74	2.38	0.50	19.41
2	4.85	2.26	0.46	27.27
3	3.95	1.90	0.48	22.00

Table 5: Asthma Female Patients

Serial number	FVC	FEV1	FEV1/FVC	BMI
1	4.74	2.38	0.50	19.41
2	4.85	2.26	0.46	27.27
3	3.95	1.90	0.48	22.00

Table 6: COPD Patients

Serial number	FVC	FEV1	FEV1/FVC	BMI
1	4.20	2.02	0.48	20.88
2	4.00	1.89	0.47	25.97

Table 7: Comparison of FVC and FEV1 in normal subjects with % predicted values

Tests	Predicted value(mean)	Measured value(mean)	% Predicted Value(mean)
FVC	3.34	2.94	81.73
FEV1	2.73	2.20	74.82

Table 8: Comparison of FVC and FEV1 in Asthma patients with % predicted values

Tests	Predicted value(mean)	Measured value(mean)	%Predicted value(mean)
FVC	5.60	3.93	70.17
FEV1	3.80	1.89	49.73

The results show that the mean value of FEV1 in normal subjects is 2.20 and Percentage of FEV1 is greater than 80% of predicted value. In case of subjects having asthma and COPD, FEV1% is 49.73 compared to normal subjects, which is highly significant. FEV1% is low when the airway resistance is high, which occurs in obstructive group of lung diseases. This observation is comparable with earlier work.^[3]

4. Conclusion

- FEV1% and FEV1/FVC are low when the airway resistance is high, which occurs in obstructive group of lung diseases. Changes in the value of FVC are insignificant.
- Obesity has no significant effect on spirometric parameters in patients with COPD but is contrary in case of asthma patients.
- Many groups around the world have confirmed the positive association between body mass index (BMI) and asthma.

- Spirometric variables FEV1 and FVC tend to decrease with increasing BMI but the ratio FEV1/FVC remains well preserved. This finding implies that the major effect of obesity is on lung volume, with no direct effect on airway obstruction.
- Losing weight in favour of adipose tissue reducing has a significant effect on improving the spirometric parameters in patients with COPD and asthma.

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