Variation Of Fev1 And Fvc With Body Mass Index In Healthy Individuals

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DOI: 10.47750/pnr.2022.13.S09

Background: The association between body mass index and lung function have been established mainly on obese individuals but however very few studies have been done in people with normal BMI or overweight group. Objective: The study is aimed to find out the association between body mass index and lung functions in non-asthmatics healthy individuals. The study data reveals the variation of FEV1 and FVC in normal healthy subjects with respect to increase in the BMI. Methodology: Sixty individuals who were healthy without any respiratory illness were selected. Their anthropometric measurements were taken. They were grouped into Group I with BMI 18.5 - 20, Group II with BMI 20 - 25, Group III with BMI 25 - 30 and Group IV with BMI >30. Their FVC and FEV1 was determined using Medispiror. The variation in FEV1 and FVC was compared with respect to BMI using appropriate statistical method. Result: The results showed that there was a decrease in the FEV1 and FVC as there is increase in the BMI. However, the decrease in FVC was relatively more than the decrease in FEV. This study shows that the decrease in the FVC is responsible for the dyspnoea as the BMI increases. Conclusion: It also demonstrates that obese individuals are at a lower risk of airflow obstruction, which means that asthma might be over diagnosed in the obese population.

Key Words: Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 sec (FEV1), Body Mass Index (BMI).

INTRODUCTION Obesity is a chronic disease characterized by the excessive accumulation of body fat that is harmful to individuals and is also known to increase morbidity and decrease life expectancy in affected subjects. Numerous studies have been done previously that demonstrate the effect of increasing BMI on the lung volumes. Several studies state that increase in the body weight causes decrease in the lung volumes. Those studies have been done in subjects having other co-morbid conditions\cite{[1-2]}. Various studies concur that gaining weight has a higher impact on pulmonary function in males than in women, owing to gender differences in fat distribution. i.e., the mechanical effect of central fat distribution on the diaphragm in men\cite{[3]}. The physical implications of truncal obesity explain in part why obese people have lower chest wall compliance, respiratory muscle strength and function, lung volumes, and peripheral airway size\cite{[4]}. Irrespective of the group of population involved in the study, it has been found out that obesity or even morbid obesity has little effect on the vital capacity (VC) or the total lung capacity (TLC). However a number of studies state that functional residual capacity (FRC) and expiratory reserve volume (ERV) can be severely decreased. The Body Mass Index (BMI) is calculated by multiplying a person's weight (kg) by the square of their height meters\cite{[5]}. A high BMI indicates that the body's fat content has risen\cite{[6-7]}. The BMI can be used as a screening tool to identify weight categories linked to higher morbidity. Higher weight has several main consequences, including greater ventilation demand, increased work of breathing, respiratory muscle inefficiency, and decreased respiratory compliance. This is exacerbated in people who are depressed Obese’ \cite{[8]}. With increasing BMI, spirometric variables such as forced vital capacity (FVC) and forced expiratory volume in 1 sec (FEV1) tend to decrease.
however they are usually within the normal range. The expiratory flow decreases in association with increase in body weight. Hence decrease in the expiratory flow in an obese individual is unlikely to indicate airway obstruction. Although numerous studies have been done about the changes in FVC and FEV1 in obese people, studies in people with BMI in the normal range and overweight is limited. Hence this study was undertaken to find out the variations in the FVC and FEV1 with respect to the changes in the BMI[9]. Spirometry is one of the most readily available and useful tests for pulmonary function. It measures the volume of air exhaled at specific time points during complete exhalation by force, which is preceded by a maximal inhalation[10].

**METHODOLOGY**'[11]

This study was done at ZaminPallavaram, Chennai, Tamil NaduINDIA. The clinical protocol was approved by the hospital Ethics Committee. A total of 67 participants(male: female ratio) aged between 15 to 80 years were included in the study. The sampling was purposive for selection of specified population based on their body weight. The selection of obese and underweight was deviant purposive technique. The study population included subjects of both sexes. Subjects who were free from any respiratory illness and other comorbid conditions were included in this study. Smokers were excluded from the study.

**Study group**

Samples were grouped into Group I with age less than 40, Group II with 40-60, Group III with above 60 years.

**Measures**

Height was measured using a clinical stadiometer in bare or stocking feet. Body weight was measured with a calibrated precision scale. Body Mass Index (BMI) is calculated using the formula:

\[
\text{BMI} = \frac{\text{WEIGHT in Kg}}{\text{SQUARE OF HEIGHT in m}}
\]

**Lung function:** Spirometry was done using Medspiro with the subject being in sitting position. Each subject was given instructions regarding the technique of spirometry.

**Data analysis:** SPSS (version 23.0.) was used for data analysis. Best of three manoeuvres was selected. Correlation between FEV1 and FVC with BMI was done using Pearsons correlation.

**Results and discussion**

A total of 58 participants (17 males and 42 females) were included and found had BMI 23.61±4.1(group 1),28.30±4.8 (group 2), 24.31±3.8kg/m²(group 3). Those with higher BMI between 25 kg/m² and 29.9 kg/m² were classified as overweight and obese group with BMI ≥ 30 kg/m². Table 1 shows the mean age, height, weight, and BMI of the three groups. The f-ratio value of BMI is 6.3709. The p-value is 0.003249. The result is significant at p < .05. Force expiratory volume in first second (FEV1) and force vital capacity (FVC), among the groups were given in table 1. The mean value of FEV1 among different age group were 1.96±0.6, 1.34±0.49 and 8.8±0.3. The result is significant at p < .05. The p-value is 0.00121. The result is significant at p < .05. Similarly the mean value of FVC were 2.28±0.07, 1.51±0.57 and 1.44±0.5 among group 1 to 3. The FVC L f-ratio value is 9.65479. The p-value is .000255. The result is significant at p < .05.

The significance of BMI over FEV1 and FVC is calculated and represented on figure. Our results showed that there was decrease in FVC(1.87 ± 0.7) and FEV1 (1.62 ± 0.58) with increase in the BMI. Correlation between FVC and BMI (figure 1) was done using Pearson's correlation which showed the r value was -0.34. Correlation between FEV1 and BMI (figure 2) showed r value of -0.29. This shows that FVC is more affected with increase in weight. Our results show that FEV1 and FVC decrease with increase in BMI. But the decrease in FVC is more than FEV1 indicating that the dyspnea is more of restrictive type with increase in BMI. According to Al Ghabain[12](2012) Obesity does not have effect on the spirometry tests (except PEF) among health non-smoking
adults. Likewise Do et al [13] found that underweight status was independently associated with decreased pulmonary function.

Obesity is becoming a major health issue nowadays. Increase in the body weight has its own impact in clinical medicine especially in pulmonary medicine due to its effect on lung volumes. Recent studies have shown that increase in body weight is associated with symptoms like breathlessness and wheezing. However, these studies suggest that the respiratory mechanics is affected rather than the airflow obstruction. Hence it is very important to know the relation between increasing BMI and lung function tests. It is well known from the previous studies that spirometric variables such as FEV1 and FVC decrease with increasing BMI [14]. But however, the variation in both FEV1 and FVC is small, usually within the normal range in healthy, obese adults and children. The FEV1/FVC ratio is usually well preserved or increased even in morbid obesity indicating that both FEV1 and FVC are affected to the same extent. This shows that the effect of obesity is less on airway obstruction.

Our finding is correlated with the finding of Paralikar et al [15]. It is well known that increase in the body weight affects the respiratory function which is determined by the interaction of lungs, chest wall and muscles. Truncal obesity causes reduction in the chest wall compliance and thereby affecting the respiration. This is evident from our data that shows that FVC declines more as the BMI increases. The reason for the same being the rise in the intra abdominal pressure with increasing BMI, having a mechanical effect on the diaphragm.

![BMI AND FVC](image_url)

Fig. 1. Variation of FVC with BMI:
Fig. 2. Correlation between FEV1 and BMI:

Table 1. Correlation of BMI, FEV1 AND FVC among group of study

<table>
<thead>
<tr>
<th>Group</th>
<th>No OF Individual</th>
<th>MEAN OF BMI</th>
<th>FEV1</th>
<th>FVC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I(≤40)</td>
<td>8</td>
<td>28</td>
<td>23.61±4.1</td>
<td>1.96±0.6</td>
</tr>
<tr>
<td>II(40-60)</td>
<td>4</td>
<td>11</td>
<td>28.30±4.8</td>
<td>1.34±0.49</td>
</tr>
<tr>
<td>III(≥60)</td>
<td>5</td>
<td>3</td>
<td>24.31±3.8</td>
<td>8.8±0.3</td>
</tr>
</tbody>
</table>

CONCLUSION:
In conclusion, our study has given us the information that there is variation in the FEV1 and FVC with relation to BMI even in normal, overweight or obese individuals and that there is gradual decrease in the FVC more when compared to FEV1. This may be helpful for the clinicians to avoid overdiagnosing obstructive airway disease in persons who are overweight and obese.

References: