

# Physical Factors Influencing FVC in Indian Adult Males

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## Abstract

**Background:** Pulmonary function tests are widely used as a valuable diagnostic tool in detecting and diagnosing various respiratory disorders like COPD, they also play an important role in monitoring therapy effectiveness and course of the disease. Normative values of pulmonary functions of healthy population are affected by different geographic, ethnic, climatic and demographic factors. The most important determining factors of Vital capacity in an individual are anthropometric factors such as age, sex, height, weight, body mass index (BMI) and body surface area (BSA)

**Aims and Objectives:** The aim of the present study was to find the correlation between Forced Vital Capacity (FVC) and anthropometric measurements like height, weight, body mass index (BMI) and body surface area (BSA) in Indian adult males.

**Materials and Method:** Fifty healthy adult males were randomly selected for the study. Ethical clearance was taken from the Institutional Ethical Committee. The physical factors namely height, weight, body mass index (BMI), and body surface area (BSA) were measured. FVC was recorded by using computerized spirometer. The correlation between the various physical factors and FVC was done using Pearson's correlation.

**Results:** Height, weight and body surface area showed significant positive correlation with FVC. However height showed the strongest correlation ( $r = 0.5807$ ), followed by BSA ( $r = 0.531$ ) and lastly weight ( $r = 0.422$ ). However the correlation of BMI with FVC was not statistically significant.

**Conclusion:** The present study showed that body height, body surface area and body weight are important determinant of FVC in Indian adult males, with height being the most important determinant.

**Keywords:** FVC, height, weight, BMI, Body Surface Area.

## Introduction

Pulmonary function test (PFT) is the comprehensive evaluation of the [respiratory system](#) in an individual. In a clinical setting, the primary purpose of pulmonary function testing is to identify the severity of pulmonary impairment in various respiratory disorders, mainly chronic obstructive pulmonary disease (COPD).<sup>1</sup>

Pulmonary function tests provide objective, quantifiable measures of lung function, which are valuable in evaluating and monitoring diseases that affect both the heart and lung function. They are also useful to monitor the effects of environmental, occupational, and drug exposures, to assess risks of surgery, and to assist in routine health evaluations performed before employment.<sup>2</sup> During last few decades, PFTs have evolved from being used as tool for physiological study to an indispensable clinical investigation in assessing respiratory status of the patients.

The development of pulmonary functions in an individual coexists with the growth of physical parameters i.e. body height and body weight. These

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physical parameters are further affected by nutrition and physical activities of growing children.<sup>3</sup> The development of pulmonary function and growth of physical parameters go hand in hand in children.<sup>4</sup>

Obese and overweight people are at a higher risk of respiratory symptoms, such as breathlessness, particularly during exercise, even if they have no obvious respiratory illness. The association between obesity and asthma leads one to question whether the mechanical effects of obesity on the respiratory system could contribute to airway dysfunction that may induce or worsen asthma.<sup>5</sup>

Age has historically been one of the major factors influencing lung function. Pulmonary maturity is reached at about 20–25 years of age,<sup>6</sup> after which lung function progressively begins to decline.<sup>7</sup> Several parameters such as Total Lung Capacity (TLC), FVC and Forced Expiratory volume at one second (FEV1), are affected by height, and they are proportional to body size.<sup>8</sup> This means that in tall individuals, who accordingly have greater lung capacity, lung volume will decrease at a greater rate compared to shorter individuals as they grow older.<sup>9</sup> Obesity can cause airway limitation, causing a parallel reduction in FEV1 and FVC, thus preserving the FEV1/FVC ratio.<sup>10</sup> Abdominal obesity is generally associated with reduced FEV1 and FVC in women and in certain age groups.<sup>11</sup>

Spirometry is the measurement of air moving in and out of the lungs during various respiratory maneuvers. It plays a pivotal role in the diagnosis and monitoring of patients with respiratory disease.<sup>12</sup> Spirometry is easier to perform and even patients with heart and lung diseases can perform it, when instructed properly by well-trained technician and or other health care provider.

The prevalence of childhood pulmonary diseases especially bronchial asthma is increasing worldwide and this necessitates the need for establishing regression equations for predicting pulmonary function in children.<sup>13</sup>

The present study is undertaken to find out which of the physical factors of an individual best correlates with FVC.

## Materials and Method

This is a cross sectional study, which was carried out in the Research laboratory, Department of Physiology, KVG Medical College, Sullia. The study and its conduct

were cleared by the ethical committee of the same Institute. Fifty male adult non smokers were randomly selected from population of Sullia taluk. Informed consent was obtained from every subject.

### Inclusion Criteria:

- 1) Male subjects in age group of 18 to 30 years.

### Exclusion Criteria:

- 1) History of cardiovascular diseases.
- 2) History of chronic obstructive pulmonary diseases and chronic restrictive lung diseases.
- 3) Smokers

### Methods of collection of Data:

- Health status was obtained by comprehensive Questionnaires.

- **Body height** was measured using wall mounted stadiometer.

- **Body Weight** was recorded with portable weighing machine

- **BMI** was calculated as per formula: Weight (Kg)/Height (meter)<sup>2</sup>.

- **Body surface area** is calculated as per Dubois formula.

$$BSA = 0.007184 \times \text{Weight}^{0.425} \times \text{Height}^{0.725}$$

Computerized data logging Spiro meter was used for recording the pulmonary function tests (UNI-EM Spiromin 6.24.9 Ink)

Vital parameters like pulse rate, BP were also recorded.

## Statistical Analysis

The correlation between body height, body weight, BMI and BSA with FVC was done using Pearson's correlation coefficient. All the analysis was done by using SPSS-20 software.

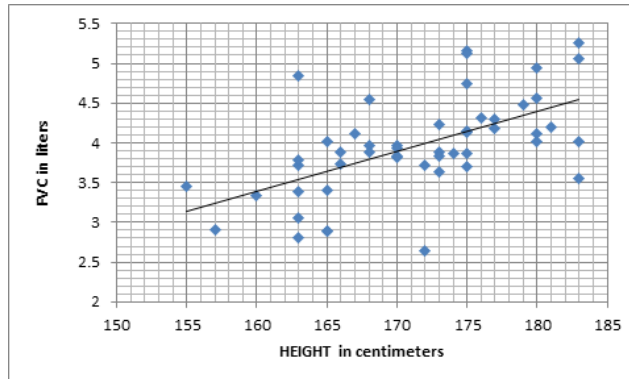
### Findings

**Table 1: Mean anthropometric measurements and FVC Of subjects**

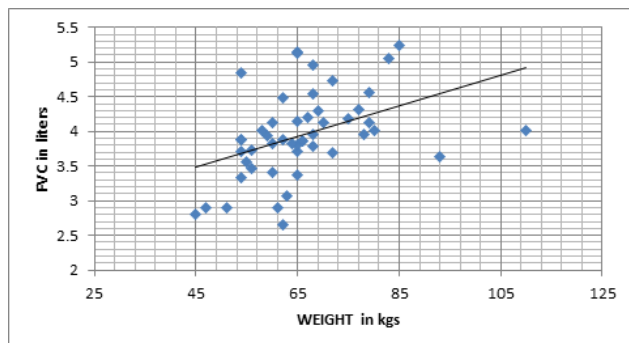
Parameter	Mean ± SD
FVC(litres)	3.95 ± 0.61
Height(centimetres)	171.4 ± 7.12
Weight(kgs)	66.12 ± 11.71
BMI(kg/m2)	22.42 ± 3.15
Body surface area(m2)	1.77 ± 0.16

**Table 2: Correlation of various anthropometric measurements with FVC**

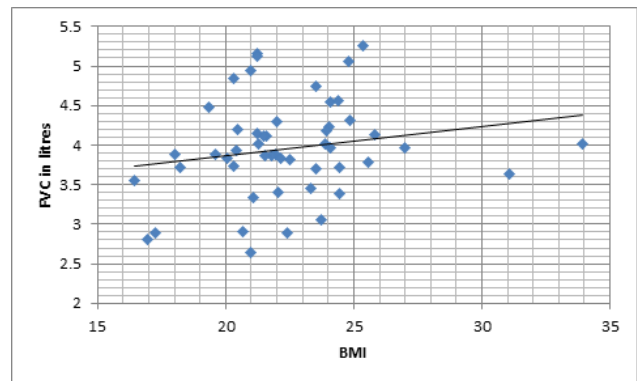
Parameters	'r' value	P value
Height	0.58	0.00001
Weight	0.422	0.002
BMI	0.19	0.186
Body surface area	0.53	0.00007



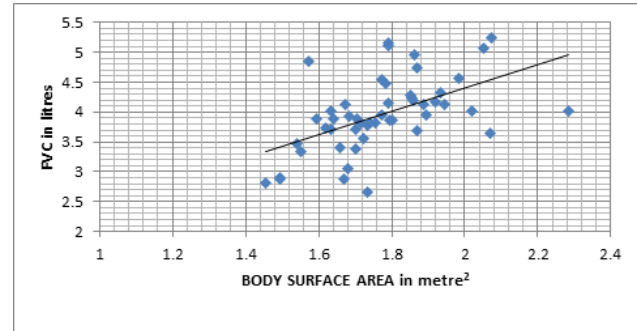
**Graph 1: Correlation of body height with FVC**



**Graph 2: Correlation of body weight with FVC**



**Graph 3: Correlation of BMI with FVC**



**Graph 4: Correlation of BSA with FVC**

### Discussion

The main objective of this study was to investigate the relationship between the lung function parameter FVC and selected anthropometric variables, which included body height, body weight, BMI and Body surface area.

The present study aimed to explore the influence of anthropometric measurements on FVC. In the present study three physical factors showed significant correlation with FVC, body height showed the strongest correlation ( $r = 0.5807$ ), followed by BSA ( $r = 0.531$ ) and lastly body weight ( $r = 0.422$ ) and BMI showed no statistically significant correlation with FVC.

Results of pulmonary function are influenced by many factors: gender, stature, race, age, technical factors, weight, and others.<sup>14</sup> The relationship between body size and spirometry values also changes with age.<sup>15</sup>

Thoracic dimensions grow more in length than in width.<sup>16</sup> A similar study done by Carel R S et al., in young navy selectees showed that thoracic perimeter and body height are the best predictors for forced vital capacity and FEV<sub>1</sub>.<sup>17</sup>

In our study it was observed that body height, body weight and body surface area were found to be positively correlated to FVC, the findings were similar to a study

done by Sachin Pawar et al.<sup>18</sup>

A similar study done by Muralidhara and Bhat, in underweight and overweight subjects, found no correlation between BMI, body fat percentage and the pulmonary functions, which concur with the present study.<sup>19</sup>

The present study showed that height was the most important determinant of FVC, which concurs with a similar studies.<sup>20, 21</sup>

Aundhakar et al. established a positive correlation between pulmonary function like FVC, Maximum voluntary ventilation, Peak expiratory flow rate and anthropometric parameters like age, height, weight, BSA, BMI etc.<sup>22</sup>

According to the American College of Sports Medicine, due to increased weight on the chest wall and diaphragm obesity has mechanical effects on respiration. Being obese also causes an increase in energy use as compared to a leaner person at the same workload, so in heavier people the respiratory muscles fatigue at lower intensities. These effects may contribute to the decreases in Functional Residual Capacity, Expiratory Reserve Volume and Total Lung Capacity. But in our study there is no correlation between FVC and BMI in young males.<sup>23</sup>

A study done by Chatterjee et al., reported that FVC, FEV1 and PEFr values increased progressively with age from 9 to 16 years and showed significantly high correlation coefficient with weight and negative correlation of FEV1 % with body surface area.<sup>24</sup>

Height is considered as better index of body size and body size is proportional to lung size. This might be the reason for its best correlation with PFTs.<sup>25</sup>

There are a few studies which however differ from the results of the present study, in some studies BSA showed less correlation than weight and in some studies height was not the primary determinant.<sup>26, 27</sup>

Many of recent studies have observed that pulmonary function shows an inverse relationship with various markers of obesity and fat distribution in children and adolescent.<sup>28</sup>

Markers of both general and visceral obesity like BMI, Waist circumference and Waist hip ratio are reported to influence pulmonary function in children

and adolescent. Some of the recent studies showed that respiratory mechanics can be affected by fat distribution pattern and central obesity, estimated by Waist circumference and Waist hip ratio independent of BMI.<sup>29</sup>

Our study has shown strong positive correlation of FVC with body height followed by BSA and body weight. But BMI has no correlation with FVC, better obesity markers like WC, WHR to be taken to study the effect of obesity on lung functions.

## Conclusion

In conclusion, our study showed body height, body surface area and body weight are the strong determinants of pulmonary function test FVC compared to BMI. BMI showed no statistically significant correlation with FVC in the present study. We conclude that physical factors have a strong influence in determining FVC, and hence these should be taken into account while standardizing the predictive values of PFT.

**Limitation** The sample size was fifty; future studies can include a larger sample size for accurate predictions. The measure of obesity in the present study was BMI; future studies can include other measures of obesity, especially measures of central obesity like waist circumference and waist hip ratio for better results.

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**Conflict of Interest:** None declared.

**Ethical approval:** The study was approved by the Institutional Ethics Committee.

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