RESEARCH ARTICLE

Gender differences in peak expiratory flow rate and timed vital capacity by computerized spirometry in medical students

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ABSTRACT

Background: Throughout the human life span, airway behavior and the clinical manifestations of airway disease show gender differences which are related to other factors such as biological and sociocultural factors. Similar studies have been conducted in various parts of India and showed wide variations even within the state with similar socioeconomic and cultural factors. Even physical activity too has influenced pulmonary function tests (PFT). The most of the studies on PFT were carried out in the Southern part of Karnataka and no previous studies on this topic were done in Bidar.

Aim and Objectives: The aim of the study was to study the gender differences in peak expiratory flow rate (PEFR) and timed vital capacity among medical students of BRIMS, Bidar.

Materials and Methods: After obtaining ethical clearance from institute, the study was conducted on healthy 18–25 years aged 200 males and 200 female undergraduate medical students in Department of Physiology, BRIMS, Bidar. After recording basic physical characteristics, lung parameters that are forced vital capacity (FVC), forced expiratory volume in the 1st s (FEV₁), FEV₃, and PEFR were recorded using Micro Quark, a PC-based spirometer, connected through serial port (RS232). Statistical analysis was done using independent sample t-test with the help of SPSS 25 version. \( P < 0.05 \) was considered the level of significance.

Results: Results revealed that there was statistically significant decrease in the mean values of FVC(L), FEV₁(L), FEV₃(L), and PEFR (L/min) in female subjects compared to male subjects \( (P < 0.01) \). Even there was statistical significant decrease in FEV₁/FVC ratio in female subjects compared to male subjects \( (P < 0.05) \).

Conclusion: Our study concluded that the values of FVC, FEV₁, FEV₃, FEV₁/FVC, and PEFR were observed to be higher in male undergraduate subjects when compared with female subjects of BRIMS, Bidar.

KEY WORDS: Spirometry; Timed Vital Capacity; Peak Expiratory Flow Rate

INTRODUCTION

A growing body of knowledge in normal physiological functions as well as in the pathophysiology of diseases of different organ systems exhibits sex-based differences that were made based on the studies conducted over the past two decades. As India is a subcontinent characterized by a varying geography and a large multi-ethnic population, Hence, a regional differences in the lung functions of healthy Indians could be expected.¹

Gender differences in other systems such as Cardiovascular system (CVS) have gained more attention in terms of research and implications, gender differences even exist in respiratory system too. Few variables that have an impact on the lung function are age, gender, and body size.²

Pulmonary function tests (PFT) which are widely used in assessing the respiratory status of an individual are evolved from tools of physiologic studies to clinical tools. Pulmonary function test results are also influenced by an individual’s
circadian rhythm, genetic and biological characteristics, physical activity, muscle structure, race, and also seasonal changes.\(^3\)

A considerable epidemiological evidence exists proving the role of gender in the incidence, susceptibility, and severity of variety of lung diseases. Compared to cardiovascular system, there appears to be a steady increase in research on influence of sex on lung diseases from year to year.\(^4\)

The most of the studies on PFT were carried out in the Southern part of Karnataka; this study has been undertaken in the Northern part of Karnataka that is in Bidar. In this study, we aimed to evaluate the effect of gender on PFT among the healthy young undergraduate medical students of BRIMS, Bidar using portable computerized spirometer available in our pulmonology laboratory as its economic, easy to use, and most widely used screening tool for normal and pulmonary disease individuals.

**MATERIALS AND METHODS**

The present study was conducted in the Department of Physiology, Bidar Institute of Medical Sciences, Bidar. Ethical clearance was obtained from the Ethical Committee of BRIMS, Bidar before starting of the study. Healthy 427 undergraduate medical students aged 18–25 years of Bidar Institute of Medical Sciences, Bidar were selected for the study and strict inclusion and exclusion criteria were followed in this study.

**Inclusion Criteria**

Healthy non-smoking medical students of BRIMS, Bidar, aged from 18 to 25 years, having normal cardiac and respiratory functions as assessed by history and clinical examination, were included in the study.

**Exclusion Criteria**

Subjects <18 years and more than 25 years were excluded from the study. Subjects with any history of respiratory illness, common cold, tobacco chewing, smoking, alcoholism, cardiovascular diseases, diabetes mellitus, hypertension, endocrinal disorders, and any medications were excluded from the study. Subjects with chest deformity, obesity, history of abdominal surgery and family history of valvular heart disease, and bronchial asthma were also excluded along with female subjects with pregnancy.

Study was conducted in healthy 18–25 years aged undergraduate medical students of BRIMS, using computerized spirometer, available in the Department of Physiology, BRIMS, Bidar. Written consent was obtained from each subject before starting the procedure.

In this study, healthy 427 subjects were selected randomly who met the inclusion and exclusion criteria, subjects were divided into two groups, that is, males and females. Of 427 healthy subjects, 219 were male and 208 were female. After the selection of subjects, purpose, procedure, and output of the study were explained to them in their own language. The study was done in all the subjects after recording the baseline parameters such as age (years), sex, anthropometric parameters such as height (cm), weight (kg), and body mass index (BMI) was calculated using Quetlet’s index.

After familiarizing and demonstration of the spirometric testing procedures, recordings were done between 11 am and 1 pm in the Department of Physiology, BRIMS, Bidar. Spirometric measurements were recorded using Micro Quark, a PC-based portable computerized spirometer, connected through serial port (RS232) available in the Department of Physiology BRIMS, Bidar.

The recordings were done after detailed instructions, demonstration, and practice of the maneuver in comfortably, relaxed sitting position. The nostrils were closed with the help of a soft nose clip. A disposable mouthpiece was placed in the subjects mouth in such a way that the mouthpiece remains fitted between the teeth and the lips, the mouthpiece was connected to the spirometer. Spirometric test was applied for 3 times and the highest values were taken for analysis. Out of 427 subjects, 19 males and eight females could not perform the spirometry tests due to fever, cough, cold, and error in performance; hence, statistical analysis was done for 200 males and 200 females.

**Statistical Analysis**

The data were analyzed using independent sample t-test with the help of SPSS 25 version to compare the pulmonary function parameters of both male and female subjects. \(P \leq 0.05\) was considered the level of significance.

**RESULTS**

The recorded anthropometric parameters such as age, height, weight, and BMI of males and females subject when compared were not statistically significant as shown in Table 1.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Males (N=200)</th>
<th>Females (N=200)</th>
<th>t-value</th>
<th>Inference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Yrs)</td>
<td>19.86±/-1.50</td>
<td>19.63±/-1.00</td>
<td>1.75</td>
<td>NS*</td>
</tr>
<tr>
<td>Height (Cms)</td>
<td>155.97+/−7.66</td>
<td>154.90+/−5.19</td>
<td>1.65</td>
<td>NS*</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>54.51+/−4.90</td>
<td>53.51+/−5.83</td>
<td>1.84</td>
<td>NS*</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>22.58+/−1.49</td>
<td>22.56+/−1.42</td>
<td>0.16</td>
<td>NS*</td>
</tr>
</tbody>
</table>

NS*–not significant \((P>0.05)\), S–significant \((P<0.05)\), BMI: Bodymassindex
In the present study, FVC and FEV values are higher in males compared to females and these results are consistent with other studies. In this study, even FEV/FVC ratio and PEFR values are also higher in males when compared to females; these results are similar with results of other studies.

In some studies, its showed that, in males, all the dimensions of the chest wall are greater as compared to females; in general, women have a smaller rib cage size than males. In another study, it was found that women have 20–25% lower lung capacity compared to men. This difference is mainly due to smaller lung size of women. When compared to females, males generate higher respiratory pressures at all lung volumes during adolescence which are triggered by the influence of testosterone, changing shape of the thorax, and respiratory muscles during puberty. As compared to females, the men have bigger lungs for the same height. Greater strength of respiratory muscles in males could be another contributing factor.

The VC of adult females was significantly lower as expected compared to adult males. This can be due to greater inspiratory muscle strength in males. No more than about 4% of the total difference of about 20% was observed. Males are characterized by more number of alveoli per unit area as compared with females and also their alveoli are larger and have greater compliance. In addition to these, there are also other factors contributing to sex differences in lung function tests which include sex hormone, sex hormone receptor, or intracellular signaling pathways, in addition to physiological and anatomical differences in the respiratory system of males and females.

CONCLUSION

We studied gender differences on PFT in 200 males and 200 female medical students of BRIMS, Bidar. Our study shows that PFT values are higher in males than females. The cause for this could be the differences in lung geometry between the genders. In males, all the dimensions of the chest wall are greater as compared to females. In general, women have a smaller rib cage size than males and lower lung diffusion capacity due to relatively narrow airways in their lungs. When compared to females, males generate higher respiratory pressures at all lung volumes during adolescence which are triggered by the influence of testosterone, changing shape of the thorax, and respiratory muscles during puberty. Males are characterized by more number of alveoli per unit area as compared to females and also their alveoli are larger and have greater compliance. The men have bigger lungs of the same height and in addition to these; there are physiological and anatomical differences in the respiratory system of males and females. Further studies can be done to know the influence of sex hormones, role of hormone receptors, or intracellular signaling pathways on gender differences in PFTs.

### DISCUSSION

The results of our study which was undertaken to investigate sex-based differences in lung function tests among undergraduate medical students of BRIMS, Bidar, are consistent with the previous studies. The lower lung function test values of female subjects in our study can be attributed to gender-related differences. When compared with male values, it is interesting to note that the values for females were significantly lower than those of the males as well as a lower lung capacity was observed in females than males.

Pulmonary function values can be affected by various factors such as ethnic variations, physical activity, environmental conditions, and other factors such as altitude of dwelling, tobacco smoking, and changes in age, height, sex, and socioeconomic status.

A number of studies have been carried out to know the influences of Gender on PFT. In the present study, there is significant in change in values of PFT that is FVC, FEV1, FEV1/FVC ratio, and PEFR in males, the possible reasons for this could be the differences in lung geometry between the genders. Compared to males, on average, females would be expected to have smaller airways and lung volumes with higher mean values of PFT in male subjects compared to females.

### Table 2: Pulmonary function test parameters in males and females

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Males (N=200) Mean±SD</th>
<th>Females (N=200) Mean±SD</th>
<th>t-value</th>
<th>Inference</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC</td>
<td>2.61±0.48</td>
<td>1.83±0.22</td>
<td>20.60</td>
<td>S*</td>
</tr>
<tr>
<td>FEV1</td>
<td>2.55±0.47</td>
<td>1.76±0.24</td>
<td>21.16</td>
<td>S*</td>
</tr>
<tr>
<td>FEV3</td>
<td>2.60±0.48</td>
<td>1.82±0.21</td>
<td>21.01</td>
<td>S*</td>
</tr>
<tr>
<td>FEV1/FVC</td>
<td>0.97±0.02</td>
<td>0.96±0.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEFR</td>
<td>7.76±0.82</td>
<td>6.31±1.05</td>
<td>15.33</td>
<td>S*</td>
</tr>
</tbody>
</table>

S*-Significant (P<0.05), NS-Not significant (P>0.05)
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REFERENCES


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