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*Original Research Article*

# A Comparative Study of Peak Expiratory Flow Rate (PEFR) and BMI in Male and Female Medical Students

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## ABSTRACT

**Introduction:** Because of increased awareness towards health, the importance of avoiding fat and staying fit is increasing day by day. To assess the pulmonary function of an individual, Peak Expiratory Flow Rate (PEFR) is preferred because it is simple and reliable diagnostic and prognostic test. PEFR is preferred among other pulmonary functions tests because of the advantages like low cost of instrument (Wright's flow meter), easy to explain the procedure even to the illiterates, easy to use and handle, easy to take the reading.

**Material & Methods:** 150 healthy adults were selected after obtaining informed consent which includes 68 male and 82 female students of Viswabharathi medical college, Kurnool, Andhra Pradesh. The study was conducted in the Department of Physiology, Viswabharathi Medical College, Kurnool, Andhra Pradesh after obtaining ethical clearance from Institutional Ethical Committee. All the subjects are informed about the procedure and an individual demonstration about the procedure has been given to all the subjects. Vital parameters like blood pressure, pulse rate, respiratory rate are recorded after clinical examination of respiratory and cardiovascular system. Blood Pressure, Height, Weight were recorded. Body Mass Index (BMI) was derived by Quetlet's index. PEFR was measured using Wright's Peak Flow meter with the subject comfortably seated during the same time of the day for all the subjects. Considering the differences between the maximum and minimum value of height recorded, the subjects were grouped into different ranges of height. Similar procedure was followed for categorizing the subjects according to their weight. The Unpaired t-test was used to compare the PEFR, Height and Weight between male and female subjects. Pearson correlation coefficient was used for data analysis.

**Results:** PEFR values are high in males when compared to females. PEFR is higher in individuals with increased height and good muscular power which is the reason for increased PEFR in males when compared to female medical students. Low body frame, decreased muscle mass which is replaced by fat deposition is the cause for low PEFR values in females when compared to male medical students.

***Key Words:*** PEFR, Male. Female, Medical students, BMI

## INTRODUCTION

Because of increased awareness towards health, the importance of avoiding fat and staying fit is increasing day by day. Pulmonary function tests are the best tests to assess the respiratory system of an individual. Among different pulmonary function tests, Peak Expiratory Flow Rate

(PEFR) is preferred as it is a simple and reliable diagnostic and prognostic test procedure diagnoses pulmonary obstructive diseases and Bronchial Asthma. [1] PEFR is introduced as a measurement of ventilator function by Adorn in 1942 and was accepted as an index of spirometry in 1949. [2] PEFR is defined as the largest expiratory flow rate achieved with a maximally forced effort from a position of maximal inspiration, expressed in Litres/min. [3] PEFR is preferred among other pulmonary functions tests because of the advantages like low cost of instrument (Wright's flow meter), easy to explain the procedure even to the illiterates, easy to use and handle, easy to take the reading. [4,5] The average PEFR of healthy young Indian males and females are around 500 and 350 Litres/minute respectively. [6] There are many studies about the relationship between PEFR and height, weight; but some of the studies have conflicting results. [7-11]

The present study was to measure PEFR in male and female medical students of Viswabharathi medical college, Kurnool and study its variation with their anthropometric measurements like Height (Ht), Weight (Wt) and Body Mass Index (BMI).

**AIM**

The aim of the present study was to study the variations of anthropometric parameters like height, weight and BMI in male and female medical students.

## MATERIALS & METHODS

150 healthy adults were selected after obtaining informed consent which includes68 male and 82 female students of Viswabharathi medical college, Kurnool, Andhra Pradesh. The study was conducted in the Department of Physiology, Viswabharathi Medical College, Kurnool, Andhra Pradesh after obtaining ethical clearance from Institutional Ethical Committee.

The inclusion criteria are: (a) medical students of Viswabharathi Medical College, Kurnool, Andhra Pradesh, (b) no history of cardiac or pulmonary diseases like bronchial asthma, cold, cough, (c) non-smokers, (d) no history of intake of any drugs which may alter cardiopulmonary efficiency, (e) no history of regular physical training or exercise.

The exclusion criteria are: (a) not willing to participate, (b) smokers, (c) regular swimmers, athletes and sports person.

All the subjects are informed about the procedure and an individual demonstration about the procedure has been given to all the subjects. The subjects were advised to have light breakfast in the morning. They were then made to relax physically and mentally for about 15 minutes in comfortable clothing. Vital parameters like blood pressure, pulse rate, respiratory rate are recorded after clinical examination of respiratory and cardiovascular system. Blood Pressure was recorded in sitting posture with Sphygmomanometer of DIAMOND make. Standing Height (Ht) was recorded without shoes in centimeters using standard height scale fixed to wall with moving head piece. Weight (Wt) was recorded in kilograms using standard weighing scale with minimal clothing. Body Mass Index (BMI) was derived by Quetlet's index from body weight in kilograms divided by square of height in meters.

BMI = BODY WEIGHT in Kgs/ (HEIGHT in m)$^2$

PEFR was measured using Wright's Peak Flowmeter in Liters per minute with the subject comfortably seated during the same time of the day for all the subjects (i.e., between 9am to 11am) to avoid diurnal variations. The subjects were asked to inspire deeply, and then blow into the

instrument's mouthpiece with nostrils closed. Each subject made three PEFR measurement maneuvers since this requires practice and maximum effort, and the highest value was considered. [12,13] Considering the differences between the maximum and minimum value of height recorded, the subjects were grouped into different ranges of height. Similar procedure was followed for categorizing the subjects according to their weight. The data was analyzed by SPSS version 20, the results are presented in mean±SD. The Unpaired t-test was used to compare the PEFR, Height and Weight between male and female subjects. Pearson correlation coefficient was used for data analysis. p-value less than or equal to 0.05 ($p \leq 0.05$) was considered as statistically significant and less than 0.01($p \leq 0.01$) was considered as statistically highly significant.

## RESULTS

Out of 150 medical students enrolled in this study, total 82 females (54.67%) were between the age of 17 to 19 years with a mean age of 18.87 years and 68 males (45.33%) were between the age of 17 to 19 years with a mean age of 18.84years. The PEFR values of male and female medical students are tabulated into different groups according to their heights and weights.

The PEFR values of male and female medical students are grouped according to different groups according to their Heights in Table-1.

The PEFR values of male and female medical students are grouped according to different groups according to their Weights in Table- 2.

**Table 1: PEFR in males and females with different Heights**

| Height (cms) | Males | | Females | | p-value | Significance |
|---|---|---|---|---|---|---|
| | No. of Subjects | PEFR (Mean±SD) L/min | No. of Subjects | PEFR (Mean±SD) L/min | | |
| 146-150 | 01 | 360.00±0.00 | 02 | 275.00±7.07 | 0.001 | HS |
| 151-155 | 01 | 490.00±0.00 | 17 | 301.76±35.04 | 0.001 | HS |
| 156-160 | 01 | 290.00±0.00 | 13 | 273.57±26.20 | 0.014 | S |
| 161-165 | 06 | 468.33±40.20 | 24 | 307.39±35.70 | 0.002 | S |
| 166-170 | 14 | 531.43±60.87 | 15 | 321.33±39.61 | 0.000 | HS |
| 171-175 | 17 | 462.94±30.77 | 09 | 331.11±34.43 | 0.025 | S |
| 176-180 | 19 | 540.00±59.07 | 02 | 265.00±7.07 | 0.475 | NS |
| 181-185 | 08 | 575.00±32.51 | 00 | 000.00±0.00 | - | - |
| 186-190 | 01 | 390.00±0.00 | 00 | 000.00±0.00 | - | - |

(HS=Highly Significant; S=Significant; NS=Non Significant)

**Table 2: PEFR in males and females with different Weights**

| Weight (Kgs) | Males | | Females | | p-value | Significance |
|---|---|---|---|---|---|---|
| | No. of Subjects | PEFR (Mean±SD) L/min | No. of Subjects | PEFR (Mean±SD) L/min | | |
| 40-45 | 00 | 000.00±0.00 | 05 | 318.00±43.24 | - | - |
| 46-50 | 00 | 000.00±0.00 | 19 | 288.42±37.46 | - | - |
| 51-55 | 04 | 487.50±51.89 | 27 | 322.22±33.32 | 0.006 | S |
| 56-60 | 06 | 511.67±72.50 | 15 | 285.33±41.03 | 0.002 | S |
| 61-65 | 10 | 508.00±70.68 | 08 | 301.25±29.00 | 0.053 | NS |
| 66-70 | 14 | 511.43±86.28 | 04 | 305.00±38.72 | 0.023 | S |
| 71-75 | 09 | 522.22±69.60 | 03 | 316.67±20.81 | 0.002 | S |
| 76-80 | 15 | 495.33±80.17 | 01 | 280.00±0.00 | 0.0145 | S |
| 81-85 | 07 | 517.14±56.48 | 00 | 000.00±0.00 | - | - |
| 86-90 | 03 | 500.00±34.64 | 00 | 000.00±0.00 | - | - |

(HS=Highly Significant; S=Significant; NS=Non Significant)

From the Tables 1 & 2, we can observe that the PEFR of male students is proportionately related to height of the individuals and PEFR of female students is proportionately related to weight of the individuals.

**Table 3: Height, Weight, BMI &PEFR of males and females**

| | HEIGHT(cms) | WEIGHT(Kgs) | BMI(Kg/m$^2$) | PEFR(L/min) |
|---|---|---|---|---|
| MALES | 171.38 | 74 | 25.43 | 500.40 |
| FEMALES | 161.99 | 55 | 20.98 | 303.78 |

**Correlations**

| | | M Height | F Height | M Weight | F Weight | MBMI | FBMI | MPEFR | FPEFR |
|---|---|---|---|---|---|---|---|---|---|
| M Height | Pearson Correlation | 1 | .039 | -.028 | .064 | -.605** | .029 | .445** | .307* |
| | Sig. (2-tailed) | | .754 | .823 | .603 | .000 | .817 | .000 | .011 |
| | N | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 |
| F Height | Pearson Correlation | .039 | 1 | -.108 | -.084 | -.106 | -.573** | .237 | .277* |
| | Sig. (2-tailed) | .754 | | .380 | .453 | .391 | .000 | .052 | .012 |
| | N | 68 | 82 | 68 | 82 | 68 | 82 | 68 | 82 |
| M Weight | Pearson Correlation | -.028 | -.108 | 1 | -.218 | .807** | -.104 | -.005 | -.341** |
| | Sig. (2-tailed) | .823 | .380 | | .074 | .000 | .397 | .968 | .004 |
| | N | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 |
| F Weight | Pearson Correlation | .064 | -.084 | -.218 | 1 | -.225 | .862** | .041 | -.055 |
| | Sig. (2-tailed) | .603 | .453 | .074 | | .066 | .000 | .737 | .623 |
| | N | 68 | 82 | 68 | 82 | 68 | 82 | 68 | 82 |
| MBMI | Pearson Correlation | -.605** | -.106 | .807** | -.225 | 1 | -.113 | -.261* | -.441** |
| | Sig. (2-tailed) | .000 | .391 | .000 | .066 | | .360 | .032 | .000 |
| | N | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 |
| FBMI | Pearson Correlation | .029 | -.573** | -.104 | .862** | -.113 | 1 | -.086 | -.189 |
| | Sig. (2-tailed) | .817 | .000 | .397 | .000 | .360 | | .487 | .090 |
| | N | 68 | 82 | 68 | 82 | 68 | 82 | 68 | 82 |
| MPEFR | Pearson Correlation | .445** | .237 | -.005 | .041 | -.261* | -.086 | 1 | .180 |
| | Sig. (2-tailed) | .000 | .052 | .968 | .737 | .032 | .487 | | .142 |
| | N | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 |
| FPEFR | Pearson Correlation | .307* | .277* | -.341** | -.055 | -.441** | -.189 | .180 | 1 |
| | Sig. (2-tailed) | .011 | .012 | .004 | .623 | .000 | .090 | .142 | |
| | N | 68 | 82 | 68 | 82 | 68 | 82 | 68 | 82 |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

**Paired Samples Statistics**

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Pair 1 | M Height | 172.84 | 68 | 7.552 | .916 |
| | F Height | 162.00 | 68 | 7.453 | .904 |
| Pair 2 | M Weight | 70.69 | 68 | 8.945 | 1.085 |
| | F Weight | 55.46 | 68 | 7.288 | .884 |
| Pair 3 | MBMI | 23.81270697805943 | 68 | 3.789973978588478 | .459601853884197 |
| | FBMI | 21.27895047639799 | 68 | 3.498191053285558 | .424217976802560 |
| Pair 4 | MPEFR | 507.50 | 68 | 70.528 | 8.553 |
| | FPEFR | 306.32 | 68 | 38.784 | 4.703 |

**Paired Samples Correlations**

| | | N | Correlation | Sig. |
|---|---|---|---|---|
| Pair 1 | M Height &F Height | 68 | .039 | .754 |
| Pair 2 | M Weight & F Weight | 68 | -.218 | .074 |
| Pair 3 | MBMI & FBMI | 68 | -.113 | .360 |
| Pair 4 | MPEFR & FPEFR | 68 | .180 | .142 |

**Paired Samples Test**

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | | Lower | Upper | | | |
| Pair 1 | M Height-F Height | 10.838 | 10.403 | 1.262 | 8.320 | 13.356 | 8.591 | 67 | .000 |
| Pair 2 | M Weight-F Weight | 15.235 | 12.709 | 1.541 | 12.159 | 18.312 | 9.885 | 67 | .000 |
| Pair 3 | MBMI - FBMI | 2.533756501661436 | 5.439641227898992 | .659653392590944 | 1.217082819289036 | 3.850430184033837 | 3.841 | 67 | .000 |
| Pair 4 | MPEFR - FPEFR | 201.176 | 74.122 | 8.989 | 183.235 | 219.118 | 22.381 | 67 | .000 |

## DISCUSSION

Pulmonary function tests are done to evaluate the different Physiological and pathological conditions. [14,15] PEFR is one among them. Among these factors, the routine normal factors influencing PEFR are anthropometric factors like age, height, weight, Body Surface Area, [16] BMI etc. PEFR is also commonly influenced by different factors like exposure to dust, smoke, chemicals etc. PEFR is also altered in some of the pathological conditions of respiratory system. PEFR can also be used for assessing the health status of an individual.

The values of PEFR obtained are within the range of 360 to 900L/min in normal adult males and 168 to 600L/min in normal adult females. PEFR is higher in individuals with increased height and good muscular power which is the reason for increased PEFR in males when compared to female medical students. Low body frame, decreased muscle mass which is replaced by fat deposition is the cause for low PEFR values in females when compared to male medical students. This further gives a clue for further study of effect of BMI and fat composition on PEFR of an individual.

The limitations of the present study are non-inclusion of parameters like Mid arm circumference, Mid-thigh circumference, Waist to hip ratio which are planned to be included in the next study; the effect of nutritional status of the subjects also should be included; the sample size also should be increased with inclusion of wide range of socioeconomic and demographic population.

## CONCLUSION

From the present study, it can be summarized that the PEFR values are high in males when compared to females. PEFR is increased in individuals with increased stature and muscle build. PEFR is decreased in females because of their low stature, decreased muscle build and increased fat deposits when compared to males. Further it can be concluded that for evaluation of PEFR, anthropometric measurements of the individual also should be considered.

### *Conflicts of Interest*

Authors declare that they have no conflicts of interest.

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