Influence of Gender and Anthropometric Parameters on Peak Expiratory Flow Rate and Vital Capacity among Medical Students of a Teaching Institution

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ABSTRACT

Introduction: Factors such as age, sex, body surface area, Body mass index (BMI), posture, physical activity, ethnicity etc which can influence Peak Expiratory Flow Rate (PEFR) as well as vital capacity. This study was aimed to find the influence of gender and anthropometric parameters on PEFR and vital capacity.

Material and methods: Healthy medical students (17-23 years) were enrolled in the study. PEFR was recorded using Mini Wight's flow meter and vital capacity was assessed using a wet spirometer. The data were analyzed statistically.

Results: The study included 90 students (59 females and 31 males). The study found that males had a significantly higher PEFR and vital capacity compared to females (p=0.0001). A statistically insignificant trend of negative correlation was noted between BMI with PEFR (r = -0.02, p= 0.84) or with vital capacity (r = -0.004, p = 0.97) in females. A significant difference was found between the observed and predicted value for vital capacity in both males and females.

Conclusion: Significantly higher PEFR and vital capacity in males could be due to the high stature, muscle build and decreased body fat. This study noted a significant difference between males and females for the observed and predicted value for vital capacity which could be due to the use of inadequate prediction equations for this population. Further studies are needed to derive a better prediction equation to correlate predicted one with the actual vital capacity.

Keywords: Peak Expiratory Flow Rate, Body Mass Index, Vital Capacity

INTRODUCTION

Peak Expiratory Flow Rate (PEFR) is defined as the largest expiratory flow rate which can be achieved by forced expiratory effort after a maximal inspiration, expressed in Litres/min.[1] It is a simple and easy method of assessing the function of large airways.[2] The advantages of using Wright's flow meter include the low cost of the instrument and the simple procedure of measurement of PEFR.[3] The average PEFR of healthy young Indian males and females are found to be around 500 and 350 Litres/minute respectively.[4] Vital capacity is defined as the maximal volume of air forcefully expelled from lungs after a maximal inspiration. There are many factors such as age, sex, body surface area, BMI, posture, physical activity, ethnicity etc which can influence PEFR as well as vital capacity.[1,5] Several studies have suggested equations to predict vital capacity from height and age of the subjects.[6,7]

According to the Asian classification, BMI of below 18 kg/m^2 and 18-23.4 kg/m^2 is considered as underweight and normal respectively. Overweight and obese defined at a BMI of 23.5–27.4 kg/m^2 and ≥ 27.5kg/m^2.[8] Hence the association of BMI with the lung function needs to be studied.[9,10] The aim of the study is to assess the association of BMI, age and gender on PEFR and vital capacity in healthy individuals.

MATERIAL AND METHODS

Healthy medical students (59 girls and 31 boys) who were willing to participate included in the study. The study was carried out in the Department of Physiology, Amala Institute of Medical Sciences, Thrissur. Study was conducted according to the standards prescribed by Institute research committee and declaration of Helsinki (1964). Those with history of smoking, bronchial asthma or any other pulmonary diseases, athletes and sports persons were excluded from the study. Anthropometric parameters like height in cm and weight in kg were taken using a stadiometer and standard weighing scale respectively from which BMI was calculated. All the measurements were done 2 hours post lunch after relaxing for 15minutes in the afternoon.

PEFR was measured with the subject in sitting position using Wright's Peak Flow Meter measured in Liters per minute during the same time of the day for all the subjects to avoid variations. The subjects were asked to take deep inspiration followed by blowing into the instrument's mouthpiece with the nostrils closed. Three readings were taken and the highest value was considered.[11]

Vital capacity was measured three times using a wet spirometer, in standing position after a deep inspiration followed by maximal expiration after applying a nose clip. The best value out of the three readings was considered. Vital capacity was calculated using separate predicted equations in males and females.[6,7]

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- Males: VC= (0.052 x height in cm) - (0.022 x Age in years) - 3.6
- Females: VC= (0.041 x Height in Cm) - (0.018 x Age in years) - 2.69

The calculated vital capacities were compared as percentage of predicted values.

STATISTICAL ANALYSIS

The data was analyzed by SPSS version 23 and are expressed in mean ± SD. Independent t-test was used to compare the PEFR, vital capacity, height and weight between male and female subjects. Pearson correlation coefficient was used to look for the association of BMI on PEFR and vital capacity. The association between predicted and obtained vital capacity was also done using Pearson's correlation test. p value ≤ 0.05 was considered as statistically significant.

RESULTS

The present study included 90 healthy medical students in the age group 18-23 years. Thirty one males and 59 females were enrolled in the study. The age of males and females were 19.35 ± 0.71 and 19.24 ± 0.82 and the BMI of males and females were 22.46 ± 3.89 and 21.89 ± 3.45 were respectively. The comparison of anthropometric parameters, BMI, PEFR and vital capacity in both male and female subjectswere given in the Table 1. The height in males and females were 1.74 ± 0.06 m and 1.57±.06 m as well as the weight in males and females was 68.05 ± 10.75 kg and 54.12 ± 9.17 kg, respectively. There is no significant difference noted in BMI among males and females. The mean PEFR and mean recorded vital capacity in males were 530.97 ± 83.64 and 3.62 ± 0.64, respectively. In females, the PEFR and recorded vital capacity were 366.10 ± 81.79 and 2.42 ± 0.36, respectively.

A significant gender difference was noted in the parameters PEFR and the recorded vital capacity (p value 0.0001). Male subjects tend to have a significantly higher mean height, weight, PEFR and vital capacity than compared to the female students. Though not statistically significant, a trend of negative correlation noted with BMI and PEFR (r=-0.02, p value 0.84) as well as BMI and vital capacity (r = -0.004, p value 0.97) in females, whereas a weak positive correlation

Parameter	Gender		p value (independent t test)
	Male	Female	
Age	19.35 ± 0.71	19.24 ± 0.82	0.5288
Height (m)	1.74 ± 0.06	1.57 ± 0.06	0.0001
Weight (kg)	68.05 ± 10.75	54.12 ± 9.17	0.0001
BMI (kg/m^2)	22.46 ± 3.89	21.89 ± 3.45	0.472
PEFR (L/min)	530.97 ± 83.64	366.10 ± 81.79	0.0001
Recorded VC (L)	3.62 ± 0.64	2.42 ± 0.36	0.0001
Predicted VC (L)	5.04 ± 0.31	3.41 ± 0.24	0.0001
% Predicted VC	71.82 ± 12.72	71.17 ± 10.78	0.800

Table-1: Distribution of anthropometrical parameters and mean values of PEFR and vital capacity among male and female study subjects.

Parameter	Total		Female		Male	
	Correlation coefficient (r)	P value	Correlation coefficient (r)	P value	Correlation coefficient (r)	P value
Height	0.59	0.0001	0.09	0.50	0.04	0.81
Weight	0.44	0.0001	0.019	0.83	0.16	0.37
BMI	0.08	0.473	-0.02	0.84	0.12	0.52

Table-2: Pearson correlation of anthropometrical parameters with PEFR in the entire study group, female and male subjects.

Parameter	Total		Female		Male	
	Correlation coefficient (r)	P value	Correlation coefficient (r)	P value	Correlation coefficient (r)	P value
Height	0.70	0.0001	0.21	0.10	0.22	0.23
Weight	0.56	0.0001	0.08	0.50	0.37	0.04
BMI	0.13	0.212	-0.004	0.97	0.23	0.19

Table-3: Pearson correlation of anthropometrical parameters with recorded vital capacity in the study group of female and male subjects.

Parameters	Total		Female		Male	
	Correlation coefficient (r)	P value	Correlation coefficient (r)	P value	Correlation coefficient (r)	P value
Recorded VC and predicted VC	0.77	0.0001	0.225	0.087	0.213	0.249

Table-4: Pearson correlation of recorded and predicted vital capacity in the entire study group, female and male study subjects.

was noted for the same in males and are represented in the table 2 and 3.

Predicted vital capacity was calculated from predictive equations and was compared with recorded vital capacity. There was a positive correlation between the recorded and predicted vital capacity in the entire study population (r = 0.77, p value 0.0001). On comparing the predicted and recorded vital capacity among males and females, there showed a weak positive correlation, which is more for females (r = 0.23, p value 0.08) compared to males (r =0.21, p value 0.25). This is represented in the table 4.

DISCUSSION

The present study helped to assess the association of height, weight and BMI on PEFR and vital capacity in males and females. This study showed that males had a significantly higher PEFR and vital capacity compared to females (p value 0.0001). Similar results were noted in the studies conducted by Behera et al.[12] and Ranjith et al.[13] among healthy adults. This could be due to the increased size of the lungs for the same height as well as the increased muscularity in males compared to females who have reduced muscle mass due to increased fat deposition. Another factor which can attribute to this result could be the influence of sex hormones, sex hormone receptors or intracellular signaling pathways. Low stature, increased fat mass as well as decreased muscle build can contribute to reduced PEFR and vital capacity in females.[14,15]

There is a trend of negative correlation is noted with BMI and PEFR (r =-0.02, p value 0.84) as well as BMI and vital capacity (r = -0.004, p value 0.97) in females. This could be due to the fact that females have a low body frame that is having a reduced muscle mass due to increased fat deposition.[13] However, previous studies have shown that a more pronounced decrease in PEFR and vital capacity were noted in male obese subjects than female obese subjects which could be explained by the distribution of fat and gender based variation in the body composition.[16,17] Further studies are needed in a larger sample population to prove the effect of distribution of fat on pulmonary function tests.

This study was noted a significant difference between the observed and predicted value for vital capacity in both males and females. This is in accordance with the results obtained in a study done by Pandey et al[18] in young Punjabi adults which could be attributed to the use of prediction equations which is not appropriate for this population, as vital capacity depends on a number of factors other than age and weight such as body surface area, distribution of fat, BMI, posture, physical activity, ethnicity etc.[1,5,18] So the inclusion of other parameters in the prediction equation would give a better estimation of vital capacity. Thus, future studies may be needed in a bigger sample size to derive a better prediction equation.

CONCLUSION

The present study showed that males had a significantly higher PEFR and vital capacity compared to females, which could be due to the high stature, muscle build and decreased body fat as compared to females. There is a trend of negative correlation is noted with BMI and PEFR (r = -0.02, p value 0.84) as well as BMI and vital capacity (r = -0.004, p value 0.97) in females This study noted a significant difference between males and females for the observed and predicted value for vital capacity which could be due to the use of inadequate prediction equations for this population. Future studies may be needed in a bigger sample size to derive better prediction equations which can correlate with recorded vital capacity more accurately.

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