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Effect of Gender Body Mass Index and Previous History of Covid Infection on Peak Expiratory Flow Rate

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ABSTRACT
Pulmonary function tests like Peak Expiratory Flow Rate (PEFR) are significant long-standing predictors of physical fitness in both genders and help in diagnosis and treatment of respiratory diseases. Lung function is known to differ with age, gender, race, Body Mass Index, socioeconomic factors, geographical region etc. Corona virus infection primarily affects the lungs and studies have shown a decline in lung function in post covid patients. The objective of the present study is to find the variation of PEFR with gender, BMI and previous covid infection among medical students. The study was conducted among 101 students in the age group 18-25 yrs in a medical college in Kerala. PEFR was measured using Wright's peak flow meter. Anthropometric measurements were done to calculate BMI. Questionnaire was used to collect details of age, gender and history of covid infection. Mean PEFR was found to be lower in females than in males. (females-309.3L min: males-517L/min) This relation was statistically significant. (P = 0.000). Mean PEFR in underweight participants was lower than participants with normal BMI (under weight-347.2L/min; Normal BMI-362.3L/min). Mean PEFR in participants with history of covid infection was lower than those without previous covid infection (with history of covid infection-363.33L/min; no history of covid infection-375.41L/min). Peak Expiratory Flow Rate is significantly lower in females than males. Mean PEFR is less in underweight and in those with history of covid infection.

INTRODUCTION

For the comprehensive health of humans, there should be a patent respiratory tract and well organized breathing mechanics[1]. Lung function differs with age, gender, socio cultural factors and geographic area of an individual and has a relation with height, weight and Body Mass Index (BMI)[2]. The Pulmonary Function Test (PFT) is governed by the strength of the respiratory muscle, compliance of the thorax, elastic recoil of the lungs, airway resistance and mechanics of respiration[3]. It has been a common practice to use PFT as tool to measure the physical fitness of both sexes which helps in getting an accurate assessment of respiratory system for the diagnosis and management of respiratory disease[4]. Peak Expiratory Flow Rate (PEFR) is a widely accepted pulmonary function test. PEFR is defined as the maximum rate at which air can be expired after taking a deep inspiration. It is expressed in litres per minute. It determines the air flowing through the bronchial tree and roughly estimates the bronchial tone[5]. Different expiratory flow rates can be used for measuring the bronchial tone. PEFR measurement is preferred as it is easily obtained by a peak flow meter and is a good predictor of lung functions in a field study[6]. The normal peak expiratory flow rate is 450-550 L/min in adult males and it is 320 -470 L/min in adult females[7].

Several studies conducted in the past two decades revealed dissimilarity based on gender in the physiological actions and in the pathophysiology of diseases of many organ systems[8]. There is also substantial documentation for the influence of gender on the susceptibility, occurrence and seriousness of various lung pathologies[9]. Now a days, BMI is commonly used for describing the anthropometric characteristics of adults and for categorizing them into groups. BMI is calculated as the ratio of body weight in kilograms and square of the body height which is taken in meters. BMI of 18.5-24.9 kg m2 is considered as Normal. BMI < 18.5 is underweight, 25.0-29.9 is overweight and BMI> 30 is obesity[10].

The covid-19 pandemic emerged as a challenge to clinicians all over the world. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), causing covid-19 disease, primarily affects the lungs. Its clinical features range from asymptomatic carriage to atypical pneumonia and acute respiratory distress syndrome (ARDS)[11]. Post covid patients especially those discharged from intensive care unit have been affected physically and mentally. They have been found to suffer from cognitive complications and muscle fatigue also[12]. In this study, we have made an effort to find the effects of gender, BMI and previous covid-19 infection on the lung functions.

MATERIALS AND METHODS

Study setting: This study was conducted in the Department of Physiology in a medical college in Kerala in February 2023 to March 2023 after obtaining clearance from Institutional ethics committee.

Study design: Cross sectional study

Study population: Medical students who were studying in the college in the academic year 2022-2023 and were satisfying inclusion and exclusion criteria.

Inclusion criteria: Participants in the age group of 18-25 years and with normal general health.

Exclusion criteria: Participants with known respiratory, cardiovascular and neuromuscular diseases, thoracic and skeletal deformities, thyroid dysfunction, diabetes mellitus, history of tobacco smoking/chewing and alcohol consumption.

Sample selection criteria: A total of 101 medical students were selected by convenient sampling technique.

Parameters recorded: Anthropometric measurements (Height, Weight, BMI) and peak expiratory flow rate (PEFR).

Study variables: Gender, BMI, history of covid infection, PEFR.

Study procedure: The objectives of the study and important information about the process were explained to all participants. Voluntary informed consent was taken from them. A questionnaire was utilized to obtain the required information like age, gender, history of COVID infection. Anthropometric measurements were taken. Height (in meters) was measured using a measuring tape. Subjects were asked to remove footwear and to stand straight to avoid errors in measurement. Weight (in kg) was measured using a digital weighing scale. All subjects were wearing light dresses and standing without footwear to ensure correct measurements. BMI was calculated using the Quetelet index.(13) BMI = Weight (kg) (Height in meters)[2].

PEFR was measured using Wright's peak flow meter. It is light weight cylinder made of plastic. It is 15×5cm and 72gm weight. It consists of a spring piston that moves freely on a rod within the instruments. The piston drives a pointer along a slot marked with a scale. The pointer shows the maximum movement of the piston. For measuring PEFR, the subjects were allowed to sit comfortably and were instructed to take a deep breathe in and keep the mouth piece of peak flow meter inside the mouth. They were asked to breathe out forcefully and rapidly only through the mouth piece by firmly holding it with their lips and

teeth. PEFR was measured by noting the position of the pointer. Three such attempts were done and highest among the values were taken for the purpose of analysis.

Statistical analysis: All the values were presented as mean±standard deviation. Significance level was assessed by Chi square test. Pearson's correlation measured the linear association. The mean statistical analysis was done using software SPSS version 25.

RESULTS

The study included 101 apparently healthy medical students in the age group of 18-25 yrs. 71 females and 30 males participated in the study. The mean value of BMI was 22.50±4.07. They were categorized to three groups based on body mass index (BMI): Normal (BMI of 18.5-24.9 kg m2), below normal / underweight (BMI < 18.5 kg m2) Above normal overweight and obesity (BMI = 25 kg m2). Out of 101 medical students, 55 participants were found to have normal BMI, 17 were underweight and 29 were found to have above normal BMI. Among the participants, 48 had a previous history of covid Infection while 53 did not have such a history. The overall mean value of PEFR is 370.99± 118.899 L min.
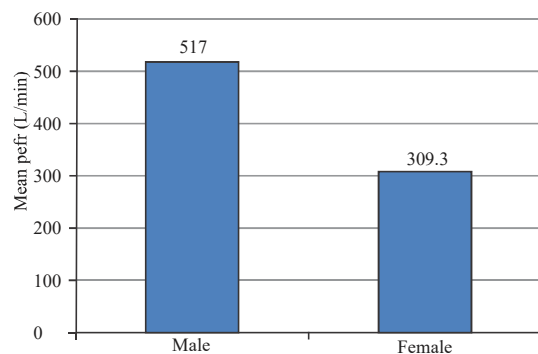

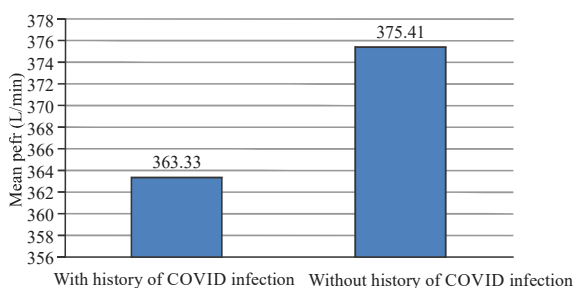Fig. 1: comparison of mean pefr between males and females

Fig. 2: comparison of mean pefr between those with and without history of covid infection

Table 1: association of gender with mean PEFR

Category	mean pefr (l/min)	chi-square value	p-value
Male	517	50.067	0.000
Female	309.3		

P<0.05 taken as significant

Table 2: association of bmi with mean PEFR

Category	mean pefr (l/min)	chi-square value	p-value
Underweight	347.2	3.726	0.444
Normal	362.3		
Overweight and obese	394.2		

P<0.05 taken as significant

Table 3: association of history of covid infection with mean PEFR

Category	mean pefr (l/min)	chi-square value	p-value
With history of covid infection	363.33	1.297	0.523
Without history of covid infection	375.41		

P<0.05 taken as significant

However, the comparison of PEFR values with history of covid infection was not statistically significant. (P = 0.523).

DISCUSSIONS

The study was done to find the variation of PEFR with gender, BMI and previous covid infection. It was observed that PEFR values of females were significantly lower than that of males. These results were comparable with the study done by Mankar et al. in healthy individuals in which they found that mean PEFR was higher in males than females. **Effect of gender on PEFR:** While comparing the mean PEFR values in male and female participants, it has been observed that the mean values of PEFR (L/min) was 517±100.52 L/min in males and 309.30±54.88 L/min in females. Mean PEFR was found to be lower in females compared to male participants. Female participants were found to have statistically significant decrease in mean PEFR compared to male participants.(P = 0.000).

Effect of BMI on PEFR: We observed that the mean values of PEFR (L/min) were 347.22±123.80 in underweight, 362.34±119.49 in participants with normal BMI and 394±119.68 in those having above normal BMI. Mean PEFR value was found to be lower in underweight than those with normal BMI. However, it was shown that the comparison of PEFR of the participants with their BMI is not statistically significant. (P = 0.444)

Effect of previous covid infection on mean PEFR: We observed that the mean values of PEFR (L/min) were 363.3 L/min in participants who had history of covid infection and 375.4L/min in those who did not have a history of covid infection. Mean PEFR was found to be lower in participants who had history of covid infection than those who had no history of covid infection. Rajkapoor et al.[1] reported that mean lung function test was higher in boys than in girls. Budhiraj et al.[14] also found that pulmonary function values were lower

in female than male participants[15]. This could be possibly due to the fact that males have larger lung size when compared to females of same height and also they have respiratory muscles of higher strength than females[16]. Females have smaller airways and lesser surface area for diffusion[17,18]. This gender differences in lung function can be attributed to a variety of variables including sex hormones, sex hormone receptors and intracellular signaling systems[19]. Variations in fat distribution and shape of the body of males and females also affects pulmonary functions[1].

In our study, the mean PEFR was lower in participants who were underweight than those with normal BMI, even though it was statistically insignificant. These findings were in accordance with the study by Cote *et al*.[20] in which lung functions were lower in underweight. This could be attributed to reduction in respiratory muscle mass in underweight, diminishing the contractility of the diaphragm and the power of the other respiratory muscles[21]. Underweight subjects were reported to have less diaphragmatic movement as compared to those having normal BMI[22]. Our study showed that the mean PEFR was lower in participants who had a previous covid infection than those who did not have a history of covid infection. However the comparison is not statistically significant. Similar findings were observed in a study by Patare *et al*., in which PEFR was found to be low in all post covid patients[23]. These findings emphasized that there could be a reduction in the lung function in individuals who had a previous covid infection.

Limitations: In this study, we have not taken into consideration about the severity of covid infection in participants i.e. whether they were home quarantined or hospitalized and about the treatment they have received. Also the duration since covid infection was not considered in this study.

CONCLUSION
This study demonstrates that the Peak Expiratory Flow Rate in females is significantly lower than in males. PEFR value is less in underweight and those who had a history of COVID infection.

ACKNOWLEDGMENT

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