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ORIGINAL RESEARCH

Correlation of PEFR with BMI in adult population in Central India (A cross sectional study)

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Abstract

Introduction: Easily available tests like PEFR can provide a better understanding of the changes in the lung function for monitoring purpose and as a diagnostic aid. The PEFR has been defined by the European Respiratory Society as the maximal flow which is achieved during the expiration which is delivered with maximal force, starting from the level of maximal lung inflation, following the maximal inspiration which was expressed in liters/min.

Aim:

1. We aimed to determine Peak Expiratory Flow Rate (PEFR) finding in adult population in tertiary Centre of central India.
2. To establish the correlation between BMI and PEFR in adult population.
3. To compare the PEFR in male and female.

Methods: 76patientsof adult age (>18yrs) who were admittedin our tertiarycentrewere retrospectively included in this study.PEFR of selected patients are obtained in standing position using Mini-Wright standard peak flow meter. The data wassummarized and analyzed.

Results: In male subjects, the mean PEFR of underweight, normal and overweight subjects were 401.81±24.42L/min, 450±28.75 L/min, and 372.35±45.76L/min, respectively. In female subjects, the mean PEFR of underweight, normal and overweight subjects were 330±32.86 L/min, 351.53±21.92L/min, and 310±14.14 L/min, respectively. Mean PEFR in male was 418.36±47.82 L/min and female was 334.76±33.56 L/min.

Conclusion: This study showed the Effect of body weight/BMI of the individual on PEFR. Based on the results of this study, negative relationship is observed between BMI and PEFR. PEFR values in overweight individual was found significantly lower than person of normal weight and persons ofunderweight.The mean PEFR of Female is lower than male.

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Introduction

The peak expiratory flow rate (PEFR) is defined as the maximum or peak flow rate that is attained during a forceful expiratory effort after taking a deep inspiration. It is expressed in liters per minute. It measures airflow through the airway and gives an idea about bronchial tone. Pulmonary functions are usually determined by respiratory muscle strength, compliance of the thoracic cavity, airway resistance, and elastic recoil of the lungs [1]. It is well known that pulmonary functions may be affected by sex, racial difference, physical activity, and physical characteristics including age, height, and body weight.[2] To measure the bronchial airflow, different expiratory flow rates are employed such as PEFR. PEFR measurement is a simple procedure using by a peak flow meter. It is a convenient tool to measure lung functions in a field study. [3,4] Peak flow measurement is a sensitive indicator to measure the strength of muscles of respiration. (5) It is considered a good indicator of bronchial hyperresponsiveness and does not require body temperature pressure saturated correction.[6] In a population of moderately to severely obstructed patients with OAD, PEFR is at least as important for prognosis as FEV1. [7,8]The average PEFR of healthy adult Indian males and females is around 500 and 350 L/min, respectively.[9] Obesity is now categorized as a "disease" condition by the World Health Organization (WHO). The WHO has recommended the use of BMI as the simplest form of defining obesity.[10] Obesity has been linked with impaired pulmonary function and airway hyperresponsiveness. [11,12] The association of high BMI with low PEFR may indicate that obesity is an important risk factor for lung function and reduced airflow. [13]This study was planned to observe the change in PEFR values with respect to BMI and find the relationship between BMI and PEFR.

Aim

1. We aimed to determine Peak Expiratory Flow Rate (PEFR) finding in adult population in tertiary Centre of central India.
2. To establish the correlation between BMI and PEFR in adult population.
3. To compare the PEFR in male and female

Material and method

Study design and participants

In this cross-sectional study we included 77 patientswith no respiratory complaints and fulfilling inclusion and exclusion criteria, who admitted in J K Hospital and LN Medical College & Research Institute Bhopal (MP) between 1September 2021 to 31 October 2021.

Inclusion criteria

1. >18 years age adult
2. Patients giving informed consent.

Exclusion criteria

1. Unstable patients
2. Patients not able to perform PEFR
3. Patients with tachypnoea
4. Spo_2<90% @RA
5. Patients with LRTI/URTI
6. Any history of recent thoracic/Abdominal, pelvis, neck, head, surgery in last 6 months.
7. Any history of cardiac disease or any systemic illness which directly affects respiratory systems.
8. Structural deformity thoracic cage

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Peak Expiratory Flow Rate (PEFR)

PEFR were obtained from the same patients at a single visit using Mini-Wright standard peak flow meter. Each patient performed the test in a standing position while holding the peak flow meter horizontally without interfering with the movement of the marker /arrow or covering the slot. Patients were instructed to take a deep breath then exhale by forceful expiration as fast as possible while maintaining an air tight seal between lip and mouth piece of the instrument as per standard techniques of American Thoracic Society. Each subjectwas asked to perform the test minimum 3 times, and the highest PEFR value was recorded for data analysis.Weight of the subjects was recorded by weighing machine. Height was measured by wall mounted measuring tape. For calculation of BMI, height and weight was used (BMI= weight in kg/height in m^2)

Figure 1: Mini-Wright peak flow meter

Definitions

Peak Expiratory Flow Rate (PEFR)-The PEFR has been defined by the European Respiratory Society as the maximal flow which is achieved during the expiration which is delivered with maximal force, starting from the level of maximal lung inflation, following the maximal inspiration which was expressed in liters/min.[1]

The BMI was calculated as weight/height2 (kg/m^2). For adults, underweight (BMI ≤ 18.5 kg/m2), normal (BMI = 18.5–24.99 kg/m^2), overweight (BMI = 25–29.99 kg/m2), and obese (BMI = 30–34.99 kg/m^2), respectively, according to the latest WHO criteria.[14]

Results

In this study, the researchers focused to establish the relation between BMI and PEFR. The result was analyzed separately for both male and female.As sex is an independent factor for variation in PEFR. In this study 77 Patients were taken.In which 21 were female and 56 were male i.e., 27.27% female and 72.72% were male. The mean height of male was 1.61±0.10m and female was 1.56±0.05m. The mean weight of male was 58.93±10.28 kg and female was 53.43±10.61 kg. The mean BMI of male was 22.62±4.88 kg/m2 and female was 20.60±4.56kg/m^2. Mean PEFR in male was 418.36±47.82L/min and female was 334.76±33.56 L/min. (Table 1)

In our study 41 patients (53.24%) were with normal BMI in which 28(36.36%) were male and 13(16.88%) were female. Number of underweight patients were 17(22.08%) in which 11 (14.29%) were in male and 6(7.79%) were female. Number of overweight patients were 19(24.68%) in which 17 (22.08%) were in male and 2(2.60%) were female. (Table 2)

In male subjects, the mean PEFR of underweight, normal and overweight subjects were 401.81±24.42L/min, 450±28.75 L/min, and 372.35±45.76L/min, respectively. In female

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subjects, the mean PEFR of underweight, normal and overweight subjects were 330±32.86 L/min, 351.53±21.92L/min, and 310±14.14 L/min, respectively. (Table 3)

Table 1: -Comparison of Variables

Variables	Male	Female
Height (m)	1.61±0.10	1.56±0.05
Weight(kg)	58.93±10.28	53.43±10.61
BMI (kg/m^2)	22.62±4.88	20.60±4.56
PEFR(L/min)	418.36±47.82	334.76±33.56

Graph 1:- Mean BMI and PEFR in male and Female

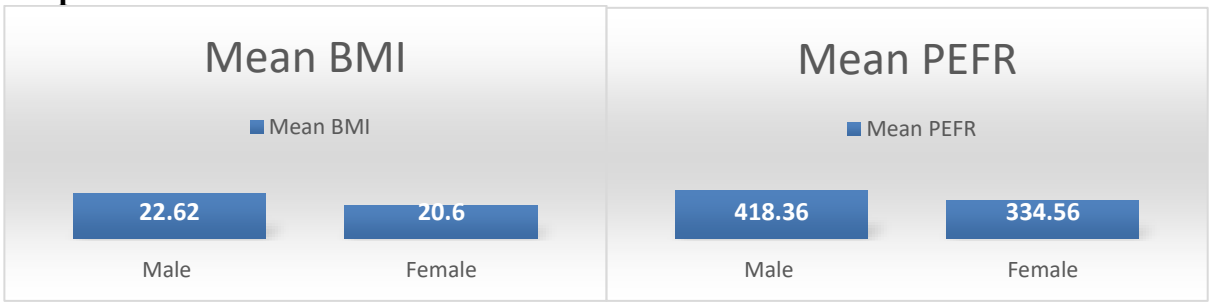

Table 2:- Distribution according BMI

	Underweight (Below 18.5)	Normal (18.5–24.9)	Over weight (Above 25.0)	
male	11(14.29%)	28(36.36%)	17(22.08%)	
female	6(7.79%)	13(16.88%)	2(2.60%)	
total	17(22.08%)	41(53.24%)	19(.68%))	

Graph 2:- Distribution according BMI

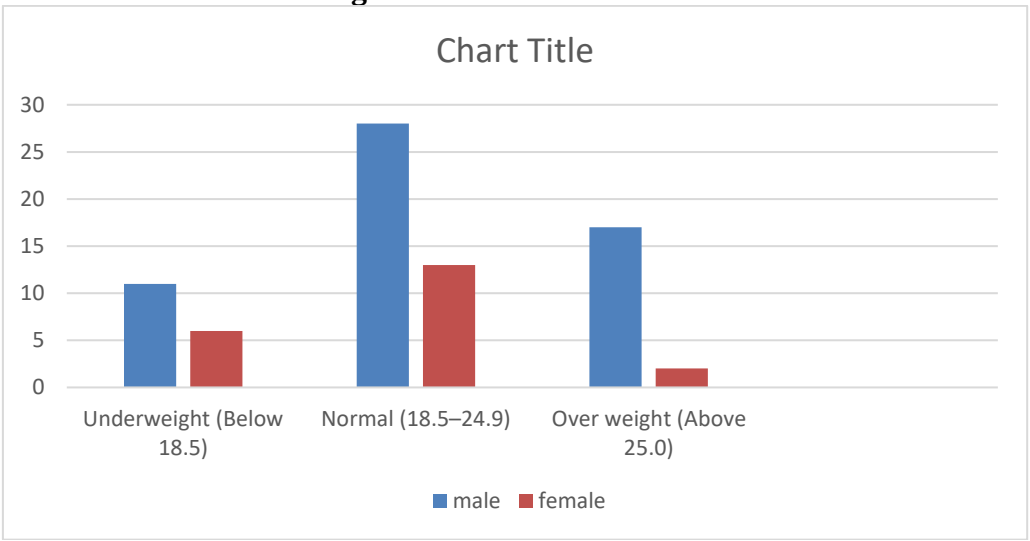

Table 3:-Correlation between BMI and PEFR

BMI (kg/m^2)	Male	Female
	PEFR(L/min)	PEFR(L/min)
Below 18.5 (Underweight)	401.81±24.42	330±32.86
18.5–24.9 (Normal)	450±28.75	351.53±21.92

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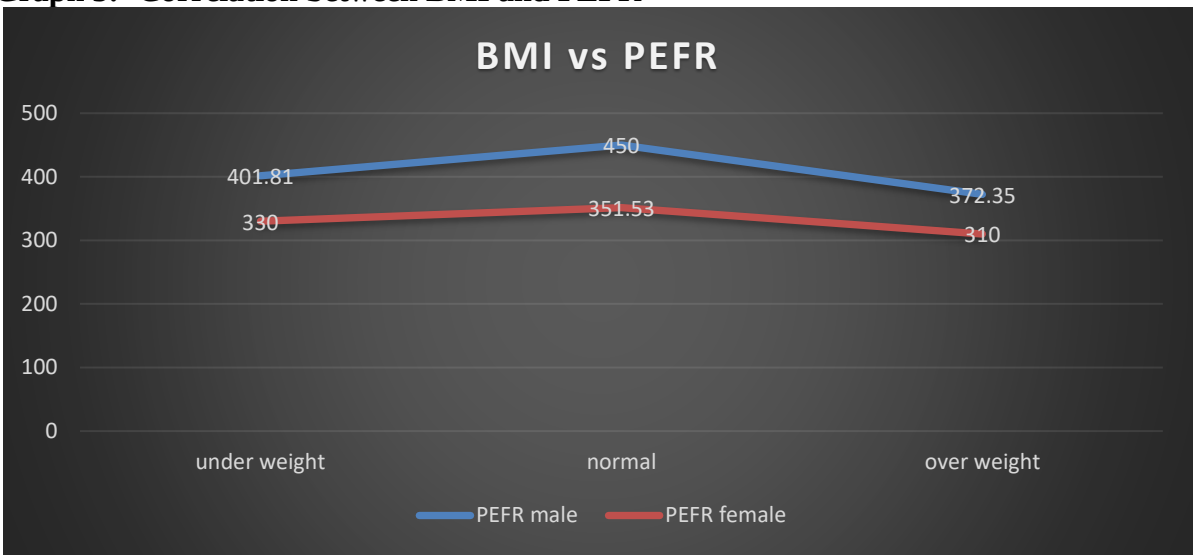
Above 25.0(Overweight)	372.35±45.76	310±14.14

Graph 3:- Correlation between BMI and PEFR



Discussion

PEFR is important tool for lung function evaluation in diagnosis treatmentfollow-up and epidemiologicalstudies. The principal factor that affects PEFR is airway diameter primarily under the control of bronchial tone. It is an expiratory parameter which measures the caliber of the airways. factors that affect PEFR are the airway resistance, strength of expiratory muscles and elastic recoil of lungs.[14] There is a relationship between height, weight, chest circumferences with PEFR. Our aim was to establish whether BMI can be considered as a predictor of PEFR.

In our study Mean PEFR in male was 418±47.82 L/min and female was 334.76±33.56 L/min.which in line with study conducted by Namita et al in which mean PEFR in male was 469 L/min and female was 365 L/min.[15] similar result was also seen study one by Prasoona et al. Ebomoyi et.al. [16], Kusal. K. Das et.al.[17], Dhungel K.U. et. al. [18] This may be due to higher mean height and muscular force in male as compared to female.

In this study, we found that BMI independently affects PEFR both in male female subjects of adult age group. In this study the mean PEFR in, underweight, normal and overweight male subjects were 401.81±24.42L/min, 450±28.75 L/min, and 372.35±45.76L/min, respectively. In female subjects, the mean PEFR of underweight, normal and overweight subjects were 330±32.86 L/min, 351.53±21.92L/min, and 310±14.14L/min, respectively.In our PEFR in overweight (BMI >25 kg/m2) is low as compared to normal and underweight in both male and female population. In study done by Sunil kumar Jena et al found similar results in which they found in male subjects the mean difference of PEFR of normal, overweight, and obese subjects were 498±52 L/min, 488±50 L/min, and 391±48 L/min. In female subjects, the mean difference of PEFR of normal, overweight, and obese subjects were 377±37 L/min, 348±39 L/min, and 325±12 L/ min.[4]Similar results found in the study conducted by Laxmikant J Borse et al in which mean PEFR in Overweight was 405.96±87.25 L/min, Normal weight was 499.04±112.69 L/minand Underweight was 450.00±106.67 L/min.[8]So there is negative correlation between BMI and PEFR.Similar study was done by different researchers, and they found BMI and PEFR was negatively correlated[inversely corelated] instudy population. [19-22]

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DecreasedPEFR in over weight subjects could be linked to several mechanisms such as mechanical effects on the diaphragm and fat deposition between the muscles and the ribs that can lead to increase in the metabolic demands and work load of breathing. [23] In obese individual, TV and FRC are low compared to normal individual as changes of elastic properties of chest wall.[24-25] At low FRC, the airway smooth muscle may be unloaded with a paradoxical increased shortness in response to normal parasympathetic tone or to other bronchial-constricting agents.[26] Thus, it has been hypothesized that in obese patients, breathing at low TV does not allow the normal stretching of airway smooth muscle during breathing, which causes the detachment of actin – myosin crossbridge of the airway smooth muscle. In normal conditions, inwhich bigger the TV the greater the ensuing bronchial dilation.[25]. This protective effect is reduced in obese individuals in comparison to lean subjects. [27,28]Therefore, the net result of airway narrowing occurs in obese subjects. Other mechanical factors may involve is due to the repeated chronic small airway closure observed in many obese subjects breathing at low TV. Repeated opening and closing of peripheral airways may determine the rupture of alveolar attachments to bronchioles that lead to exacerbation of the airway narrowing.[29] It has been well established that obesity is also characterized by low-grade systemic inflammation that spills over into the blood of a series of mediators, known as adipokines, which induce an inflammatory activated state in organs distant to adipose tissue. Adipokines include interleukin-6, tumor necrosis factor-α, eotaxin, vascular endothelial growth factor, and monocyte chemotactic protein that have been associated with asthma and may have a role in the common state of inflammation.[21] These inflammatory mediators may involve in airway narrowing, leading to decrease in PEFR.

Conclusion

Present study is based on the premise that the body weight height age and sex of an individual has an effect on lung function and in turn PEFR.This study is to examine the Effect of body weight/BMI of the individual on PEFR. Based on the results of this study, negative relationship is observed between body weight, as rated by the BMI, and PEFR. PEFR values of overweight individual are significantly below than their normal weight and underweight counterparts. Causes for this difference are not clearly known but altered mechanical muscular activity due to adiposity,decreased bronchodilation deep inspiration, altered airway caliber and increase respiratory resistance along with remodeling of respiratory passage due to circulating inflammatory mediators may be responsible for less PEFR seen in overweight individuals.

Limitation

Due to small sample size and cross-sectional study, these results cannot be generalized for whole population, so there is need of further study of large sample size and at multi centre study.

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Abbreviation

BMI-Body Mass Index,PEFR- Peak Expiratory Flow Rate,OAD- Obstructive Airway Disease,LRTI- Lower Respiratory tract Infection,URTI- Upper Respiratory tract Infection,Spo_2 - oxygen saturation, FEV_1-Forced Expiratory Volume in First Second, FVC-Forced Vital Capacity,FRC- Functional Residual Capacity,TV -Tidal Volume

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Conflict Of Interest-- Nil

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