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Original Research

Correlation between Body Mass Index and Mean Arterial Blood Pressure on Pulmonary Function in Asthmatic Individuals

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Abstract:

Introduction: Due to modernized lifestyle large number of population are becoming obese and also are suffering from respiratory and cardiovascular disorders. The population with asthma is increasing globally. Spirometry is a traditional method used to assess asthma and severity. Several studies have reported that asthmatic patients have developed arterial hypertension and there is some relationship between these two diseases along with BMI. But still few controversies existed.

Aim: The aim of this study was to evaluate the correlation between Body Mass Index (BMI), Mean Arterial Blood Pressure (MABP), and Spirometric parameter Peak Expiratory Flow Rate (PEFR) in Patients of Asthma.

Material and Method: This is a cross-sectional study conducted in Physiology department, in collaboration with the TB and Chest Diseases department of Jawaharlal Nehru Medical College, JNMC, AMU, Aligarh from 26th January, 2024 to 26th January, 2025. Forty Asthmatic individuals, aged between 18–40 years were recruited in the study and have been evaluated for weight, height, Arterial blood pressure, and PEFR (spirometric parameter). The reason for choosing PEFR is that it's a reliable representative for functioning of airways. Correlation test have been performed to find the correlation between body mass index and peak expiratory flow rate, and mean arterial blood pressure.

Result: *R*-value obtained was 0.138 (r = 0138) have been observed between PEFR and BMI which revealed a weak negative correlation, revealing that as BMI increases PEFR is decreased. Between MAP and PEFR a linear correlation is revealed.

Conclusion: This Study has confirmed a strong association between PEFR and MAP; and a weak association between BMI and PEFR in Asthmatic individuals.

Keywords: Asthma, Body Mass Index, Mean Arterial Blood Pressure

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INTRODUCTION

Asthma is a serious global health concern which is affecting approximately 300 millions of people all around the world, and also leading to 1,000 deaths per day.[1] Peak Expiratory Flow Rate is the maximal flow achieved during expiration while expiring with a maximum force in accordance to GINA guidelines.[2] PEFR is a critical parameter of lung function used to assess and monitor severity of respiratory conditions like asthma. Its values are influenced by several factors of anthropometry and environmental conditions as well.[3]

In children and adolescence age group, body mass increases with skeletal growth. In adults, weight gain occurs due to accumulation of fat. However, in physically trained individuals weight gain results from increased muscle mass and bone mineralization with a minimal fat gain.[4] Body mass significantly affects pulmonary function. In Obese individuals, abdominal mass limits diaphragm movement and reduces pulmonary function test (PFT) values.[5] In individuals with asthma PEF will decrease as the severity of disease increases.[6]

Blood pressure is closely linked to weight; gain in weight is known risk factor for elevated blood pressure. Gain in weight is also associated with cardiovascular, respiratory, and other metabolic disorders.[7,8]

There is literature on correlation with respect to targeted population including cardiovascular, respiratory, and metabolic disorders.[9] However, there are few controversies noticed. It's necessary to know if improvement in anthropometry MAP in turn improves PEFR or vice versa. Hence this study was performed to correlation of BMI, MAP on PEFR in asthmatic patients.

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MATERIAL AND METHOD

A cross-sectional study have been performed in Physiology department, in collaboration with department of pulmonary medicine, Jawaharlal Nehru Medical College, JNMC, AMU, Aligarh from 26th January, 2024 to 26th January, 2025, on 40 asthmatic individuals. Informed consent was obtained from all the individuals after letting them know regarding purpose of study. Institutional Ethical clearance was obtained.

Sample size calculation: Sample size was obtained using the formula below.

$$N = ((1.96 \times S.D)/(\text{Marginal of error}))^2$$
$$N = ((1.96 \times 16.44) / (5))2 = 41.50$$

Study population: Asthmatic patients aged 18-35 years; genders both male and female were included in the study. People of above age group have been recruited, as most of patients develop asthma in this age group and also they can perform spirometry effectively. Study subjects were individuals with asthma visiting respiratory department OPD in Jawaharlal Nehru Medical College, JNMC, AMU, Aligarh.

Inclusion criteria: Patients diagnosed with asthma as per GINA 2024 guidelines.

Exclusion criteria: Patients with known respiratory illness other than asthma have been excluded from the study.

BMI Measurement:

$$\text{Body Mass Index} = \text{Weight (kg)} / \text{Height } (m^2);$$

The above formula has been used for calculating BMI of our study participants. Weight was measured with the help of a weighing apparatus which was standardized and height was measured with the help of a measuring tape or a meter ruler which were rounded off. Based on the BMI study participants were classified as underweight, normal, overweight, and obese, respectively.

MAP Measurement

A standardized digital sphygmomanometer was used for recording blood Pressure. As per the standards, blood pressure was measured thrice with fixed interval of five minutes in between. Obtained readings were of the left arms, and the average of which were considered as the blood pressure of a patient. The Mean Arterial Blood pressure was obtained by using the formula

$$\text{MABP} = \text{Diastolic blood pressure} + 1/3\ (\text{Pulse pressure}).$$
$$\text{Pulse pressure} = \text{systolic blood pressure} - \text{diastolic blood pressure}$$

PEFR Measurement

Peak expiratory flow rate was obtained with the help of a spirometer (MIR Spirolab). Instrument was initially calibrated then each of the study participants were asked to exhale to the maximum possible into the mouthpiece attached to the device after a deep inspiration. The procedure was repeated thrice, and the highest readings were recorded. The piece of each individual is discarded after usage.

STATISTICAL ANALYSIS

Obtained data was analyzed using the statistical software (SPSS 22.0 version). Parameters are depicted as MEAN + STANDARD DEVIATION. Analysis of correlation was also done for determining the relationship between the parameters Body Mass Index and Mean Arterial Blood pressure which are taken as (independent variables) where as Peak Expiratory Flow Rate was taken as (dependent variables). This was significant as *p-value* obtained was <0.05.

RESULTS

In the current study, the mean BMI of asthmatic individuals is 29.58 ± 5.40 as in (Table 1). The Mean Arterial Blood pressure is 84.51 ± 5.13, whereas the Peak Expiratory Flow Rate is 7.84 ± 1.18. Weak negative correlation was observed between BMI and PEFR as in (Table 2), while a strong positive correlation was found between Mean Arterial Blood Pressure and Peak Expiratory Flow Rate in asthmatic individuals (RBP = 0.562, n = 40, p<0.001). The parameters have been tabulated below (Table 2 and 3). From the above we can clearly interpret that in asthmatic individuals as PEFR decreases (lung compliance decreases) while MAP increases.

Table 1: The mean BMI of asthmatic individuals.

PARAMETERS	MALE	FEMALE
Age (years)	33.11 ± 6.38	32.19 ± 7.19
Gender (M/F)	27 (67.5%)	13 (32.5%)
Demographic data of participants in study (Asthmatics).		
PARAMETERS	MEAN	STD. DEVIATION
BMI (kg/m_2)	29.58	5.40
MABP (mmHg)	84.51	5.13
PEFR (L/ min)	7.84	1.18

Table 2: Weak negative correlation was observed between BMI and PEFR.

PARAMETERS	CORRELATION	*P*-VALUE
BMI v/s Peak Expiratory Flow Rate	-0.138	0.402
MABP v/s Peak Expiratory Flow Rate	0.562	<0.001**
Correlation between study parameters. ** indicates - Pearson correlation test (Significant)		

Table 3: A negative correlation was observed in the categories of overweight and obese with PEFR.

Body Mass Index VS Peak Expiratory Flow Rate	CORRELATION	*P*-VALUE
Low-weight	0.105	0.620 (Non Significant)
Ideal (Normal)	0.036	0.215 (Non Significant)
Overweight -0.124 0.342 (Non Significant)		
Obesity	-0.147	0.535 (Non Significant)
Correlation coefficient for Body Mass Index separate sub categories. P is the Pearson correlation coefficient test		

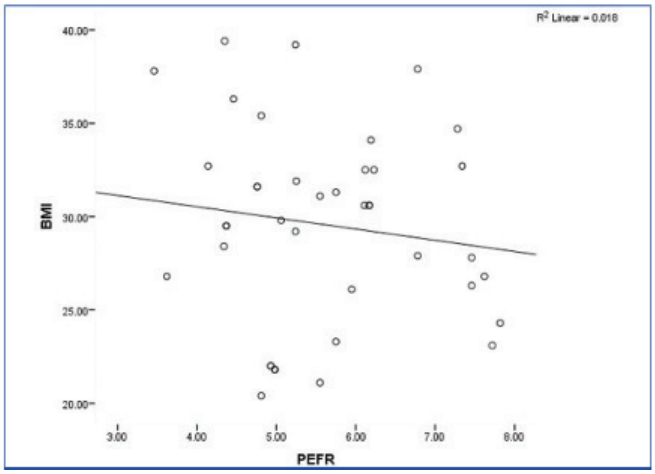

Figure 1: Relationship between parameters Body Mass Index and Peak Expiratory Blood Flow.

DISCUSSION

Excess body mass like chest fat, poses a significant health risk which impacts respiratory functions. The adipose tissue accumulated compresses respiratory muscles and there by reduces lung expansion which in turn leads to decreased chest wall compliance and lung volumes.[10] Asthma as it's an obstructive airway disorder PEFR reduces further in obese individuals. Pulmonary function impairment and hyper-responsiveness of airways are also closely linked with increased adiposity.[11]

The Peak Expiratory Flow Rate is a parameter used for measuring the functioning of lung. This study was aimed to find the relationship between Body Mass Index, Mean Arterial Blood Pressure on Peak Expiratory Flow Rate in asthmatic individuals of age 18-40 years. A negative correlation was obtained between the parameters BMI and PEFR with (r = -0.138).

The study revealed a direct relationship between PEFR and MAP. Increased blood pressure, occurs with decrease in the compliance of lung which restricts the cardiac output and venous return.[12,13] In asthmatics due inflammation in airways the lung compliance decreases and blood pressure increases.

MABP is considered a more accurate indicator of tissue perfusion than blood pressure, which is why this has been used in the study. A MAP between 70 and 110 mmHg, with a minimum of 65 mmHg is generally accepted adequate for perfusing vital organs. Prolonged MAP values below 65 mmHg can impair tissue perfusion, depriving these organs of necessary oxygen.[14,15]

This study used BMI as a measure of body mass, but it doesn't account for fat distribution. If obesity affects lung volume mechanically, abdominal and thoracic fat would restrict diaphragm movement, while fat in hips and thighs would have minimal impact. Despite which BMI remains the gold standard for assessing obesity and overweight.[16-18]

CONCLUSION

This present study has confirmed the association of body weight increase (Body Mass Index) and Mean Arterial Blood Pressure with parameter of pulmonary function test (PEFR) in asthmatic individuals. Hence weight loss, lifestyle modifications, and taking medications regularly may reduce exacerbations of asthma, and reduce chances of other cardiovascular and pulmonary disorders.

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