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ORIGINAL ARTICLE

A STUDY ON EFFECT OF BODY MASS INDEX ON MID EXPIRATORY FLOW RATE AMONG HEALTHY YOUNG INDIVIDUALS OF GUWAHATI CITY

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ABSTRACT: AIMS AND OBJECTIVES: To study the effect of Body Mass Index on Mid Expiratory Flow Rate among healthy young individuals. **MATERIALS AND METHODS:** A Cross sectional study was carried out among hundred healthy young individuals including equal numbers of male and female subjects of 18-24 years of age of Guwahati City. Body Mass Index was estimated by using Quetlet's Index. Obesity was classified according to WHO classification of BMI for Asia-Pacific region Mid Expiratory Flow Rate was measured by MEDSPIROR (Electronic turbine type Expirograph) in the Department of Physiology, Gauhati Medical College, Guwahati. Statistical analysis was carried out by calculating the Mean, Standard deviation and Pearson's Correlation Coefficient for relevant groups as needed and 'p' values for inter group comparison were calculated by using ANOVA in SPSS-22. **RESULTS:** The Mid Expiratory Flow Rate in female subjects was found to be significantly lower than in male subjects in corresponding groups ($p<0.001$). The MEF values in males were 338.80±16.86, 326.84±24.90 and 326.32±18.46 in normal BMI group, preobese and Class I obese group respectively. In female subjects, the MEF values were 272.00±26.53, 258.15±19.12 and 232.79±13.33 in normal BMI group, preobese and Class I obese group respectively. Also, there was a negative correlation between MEF and BMI in both male and female subjects and both were found to be statistically significant. In male subjects, the decrease in MEF was found to be significant between normal BMI group and preobese group as well as between normal BMI and Class I obese group, but it was not significant between preobese and Class I obese group. In female subjects, the decrease in MEF was significant between normal BMI group and Class I obese group as well as between preobese and Class I obese group, but it was not significant between normal BMI group and preobese group. Moreover, no individual was found to be underweight (BMI <18.5 kg/m^2) and Class II obese (BMI ≥ 30kg/m^2). **CONCLUSION:** There was a negative correlation found between Mid Expiratory Flow Rate and Body Mass Index in both male and female subjects with significantly lower values of MEFR in females than in males.

KEYWORDS: Body Mass Index, Obesity, Mid Expiratory Flow Rate, Expirograph.

INTRODUCTION: Nutrition is the vital element of basic survival of living creatures and is the key component of human civilization. When a person is overfed and energy intake persistently exceeds that of expenditure, most of the excess energy is stored as fat and body weight increases. Similarly, loss of body mass and starvation occur when energy intake is insufficient to meet the body's metabolic needs. Thus overeating and defective eating are the common causes of nutritional disorders.

In recent times, obesity is considered as a major global health problem. Obesity may be defined as an abnormal growth of adipose tissue due to enlargement of fat cell size (Hypertrophic obesity) or an increase in fat cell number (Hyperplastic obesity) or both.[1] BMI is a simple index of weight for height, which may be defined as body weight in Kilogram divided by height in meter square.

Obesity is usually defined as 25% or greater total body fat in men and 35% or greater in women. Although percentage of body fat can be estimated with various methods such as measuring skin-fold thickness, bioelectrical impedance or underwater weighing, which are rarely used in clinical practice, whereas BMI is commonly used to asses obesity.[2] It is widely used in epidemiological studies to classify obesity and overweight by virtue of its ease of measurement and reproducibility. Moreover, BMI is independent of age and sex variation within a particular Race and Ethnic group.[3,4]

Ventilatory capacity is the term used to describe the maximal ability to move gas rapidly in and out of the lung. It includes both maximal breathing and single forced inspiration and expiration. Ventilatory capacity integrates the characteristics of the whole respiratory apparatus and its control mechanisms. It determines the maximal exercise ability. A reduced capacity secondary to narrowing of airways is the commonest cause of undue breathlessness on exertion.[5] In Physiological assessment of respiratory system in patients of all ages, tests of Ventilatory capacity constitute the first and sometimes the only test. The tests are used for clinical management in respiratory surveys and for assessing respiratory impairment and can be performed by most subjects from the age of five years, but failure to do so can provide useful information.[6,7] Forced mid-expiratory flow (FMF or FEF 25%-75%) detects mild airflow limitation.[8] The maximal forced expiratory flow, midexpiratory phase (FEF 25%-75%) as a measure of small airway disease, has been shown to be a sensitive measure of airway obstruction.[9] and a predictor of airway hyper responsiveness. Over years, many have hoped to be able to detect early changes in small airway function, FEF 25%-75% seem to be an excellent candidate for the job.

In our study, Body Mass Index of fifty male and fifty female healthy young individuals in the age group of 18-24 years was calculated by measuring height and weight of the subjects. Mid Expiratory Flow (Forced Expiratory Flow 25%-75%) was measured by using 'MEDSPIROR' between 10am–12pm for three times and the best of the three values was taken. There was a negative correlation between BMI and FEF 25%-75%.

MATERIALS AND METHODS: Type of Study-Cross Sectional Study:

Study Procedure: BMI was calculated by using Quetlet's Index:[10] BMI = Weight in Kg/Height in m^2. Weight was recorded without shoes and with light cloths on a bathroom type of weighing machine with a least count of 500 grams. Height was measured by an Anthropometer with graduation from 0-200 cm. The subject was made to stand barefoot against a wall on which a measuring scale was placed. The subject had to stand erect, feet parallel and heels, buttocks, shoulder and occiput touching the vertical rod of the anthropometer. The subject's head was held erect, eyes aligned horizontally and ears vertically without any tilt. The horizontal bar at right angle to the vertical rod was placed touching the vertex. The height was measured to the nearest of 0.1cm.[11]

Mid Expiratory Flow/Forced Expiratory Flow 25%-75% was measured by 'MEDSPIROR' which is an electronic turbine type of Expirograph. The recording was taken during 10 am-12 pm and out of three recordings best value was taken.

Sample Size: Fifty healthy young male individuals and fifty healthy young female individuals in the age group of 18 – 24 years were included in the study.

Inclusion Criteria: Healthy young individuals of both sexes in the age group of 18-24 years were included in the study.

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Exclusion Criteria: Subjects with known respiratory diseases like Bronchial Asthma, Bronchitis, Tuberculosis, Emphysema etc., subjects with contraindication for Pulmonary Function test.[12] and subjects with known Cardiovascular disease were excluded from the study.

Data Collection Procedure: Relevant information about the subjects was obtained by taking their medical history and examining their height, weight and Mid Expiratory Flow Rate. Results obtained from these examinations were recorded.

Instruments: For measuring weight, bathroom type of weighing machine was used. For measuring height, Anthropometer was used and MEFR was measured by 'MEDSPIROR' (Expirograph).

Quality Control: The instruments used for the study were checked for quality control before doing the study.

Plan of Analysis: The data collected from the study was organized using Microsoft Office Excel 2007 and redistributed into various groups as needed for the study. Mean, standard deviation and Pearson's correlation coefficient were calculated for relevant groups as needed. 'p' values for inter group comparison were calculated by using ANOVA in SPSS – 22.

Ethical Considerations: Consents were taken from each of the participants by signing in previously prepared Informed Consent Form.

OBSERVATIONS AND RESULTS: Our study comprised of hundred young adult individuals between age group of 18–24 years including equal number of both male and female individuals of Guwahati city. Out of the total cases selected for study, 50 belong to male and 50 belong to female population. BMI of the subjects was calculated after measuring their weight and height. In our study, obesity was classified according to WHO classification of BMI for Asia-Pacific region (ANNEXURE – I).[13] BMI ≥23 was considered as overweight, BMI between 23–24.9 was considered as pre-obese, BMI between 25-29.9 was considered as Class I (Obese-I) and BMI ≥30 was considered as Class II(Obese-II). It has been found in our study that the mean age of male and female population was 20.72±1.84 and 20.66±1.89 respectively. Out of the fifty male subjects selected for study, 20 were found to belong to normal range of BMI, 17 were of pre-obese variety and 13 were found to belong to Class I obese. Among the fifty female subjects, 28 were found to belong to normal BMI range, 10 were of pre-obese variety and 12 were found to belong to Class I obese. No individual with BMI less than 18.5 (Underweight) or more than 29.5 (class II obese) was found in our study. This is shown in Table 1 and Table 2.

The Mid Expiratory Flow Rate in both male and female subjects was found to be decreased with increasing BMI in our study. In Table 1, the MEF values are shown in male subjects in different groups of BMI. The Mid Expiratory Flow Rates were 338.80±16.86, 326.84±24.90 and 326.32±18.46 L/min in normal BMI, Preobese and Class I obese respectively. The difference between normal and preobese groups and as well as between normal and Class I obese groups was found to be statistically significant ($p<0.05$) while the difference between preobese and Class I obese groups was not found to be statistically significant ($p>0.05$). Further analysis also shows a negative correlation of MEF and BMI with a Pearson's Correlation Coefficient-0.302 (significance p=0.033).

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Among the female subjects, MEF values are shown in different groups of BMI in Table 2. The MEF values were 272.00±26.53, 258.15±19.12 and 232.79±13.33 in normal BMI group, preobese and Class I obese respectively. The difference between normal and Class I obese groups and Class I obese and preobese groups was found to be statistically significant ($p<0.05$) while the difference between normal BMI and preobese group was not found to be statistically significant ($p>0.05$). MEF showed a negative correlation with BMI with Pearson's Correlation Coefficient-0.506 (Significant at $p = 0.01$)

DISCUSSION: In our study, Mid Exploratory Flow Rate was found to be decreased with increase in BMI in both male and female subjects. In male subjects, the decrease was not found to be statistically significant between preobese and Class I obese groups. In female subjects, the decrease in MEF was statistically significant both between normal BMI and Class I obese and between preobese and Class I obese groups but it is not statistically significant between normal BMI and preobese groups. This is shown in Table.1 and Table 2. In our study, Mid Expiratory Flow Rate showed a negative correlation with Body Mass Index in both male and female subjects and both are found to be statistically significant. This is comparable to that of the studies which also showed negative correlation of MEF with BMI.[14] Similar findings were also observed by N Anupama et al. in 2012 who studied MEF and BMI among individuals exposed to automobile exhaust.[15]

Moreover, it is seen in our study that MEF values are significantly lower ($p<0.001$) in females as compared to males among corresponding groups. Similar finding was found by Anindita Singha Roy et al, in 2013 in their study "Gender difference on the effects of BMI in prediction of spirometric reference values in healthy young Indian adults" which showed significantly lower MEF in females than in males.

The decrease in MEF is an indicator of small airway obstruction which can be attributed to increase in circulatory levels of cytokines, chemokines and acute phase proteins as well as cytokine receptors. These changes lead to hyper responsiveness of the airway leading to narrowing of small airways.[16]

CONCLUSION: The fact that obesity has a profound effect on pulmonary volumes and capacities as well as flow rates is well established now. The pattern of pulmonary function test in obesity is mostly inclined towards restrictive pattern. However in our study, decreased Mid Expiratory Flow Rate was found among obese individual, which is indicative of obstruction in small airways. This can be attributed to the airway hyper responsiveness due to increase circulating levels of cytokines that is seen in obesity. As early changes in small airway function can be detected by measurement of MEFR, there is obvious scope for further study regarding association of pulmonary function test with circulating cytokines.

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BMI Group (Kg/m^2)	**No. of Cases (Total = 50)**	**MEF (Lit/min)**	
		Mean	**SD**
Normal (18.5 – 22.9)	20	338.80	16.86
Pre Obese (23 – 24.9)	17	326.84	24.90
Class I Obesity (15 – 29.9)	13	326.32	18.46

Table 1: Showing the mean values of Mid Expiratory Flow rate in different BMI Groups among the male subjects

BMI Group (Kg/m^2)	**No. of Cases (Total = 50)**	**MEF (Lit/min)**	
		Mean	**SD**
Normal (18.5 – 22.9)	28	272.00	26.53
Pre Obese (23 – 24.9)	10	258.15	19.12
Class I Obesity (15 – 29.9)	12	232.79	13.33

Table 2: Showing the mean values of Mid Expiratory Flow rate in different BMI Groups among the female subjects

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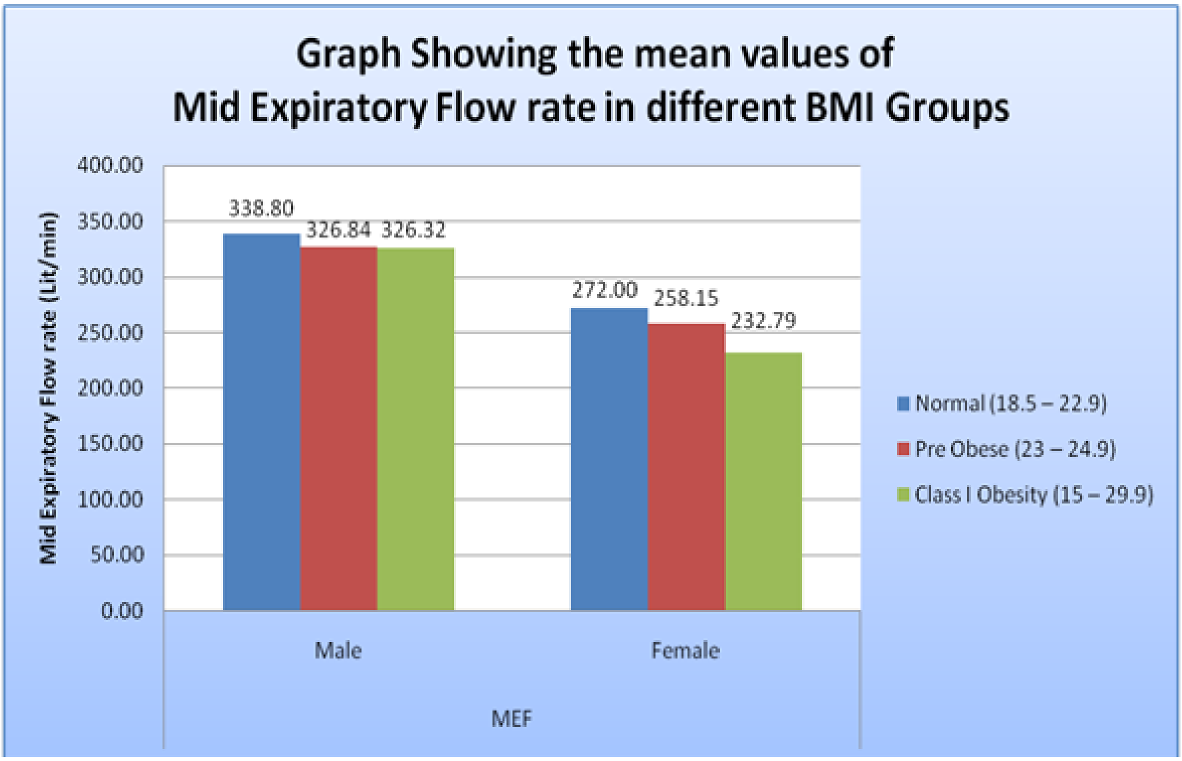

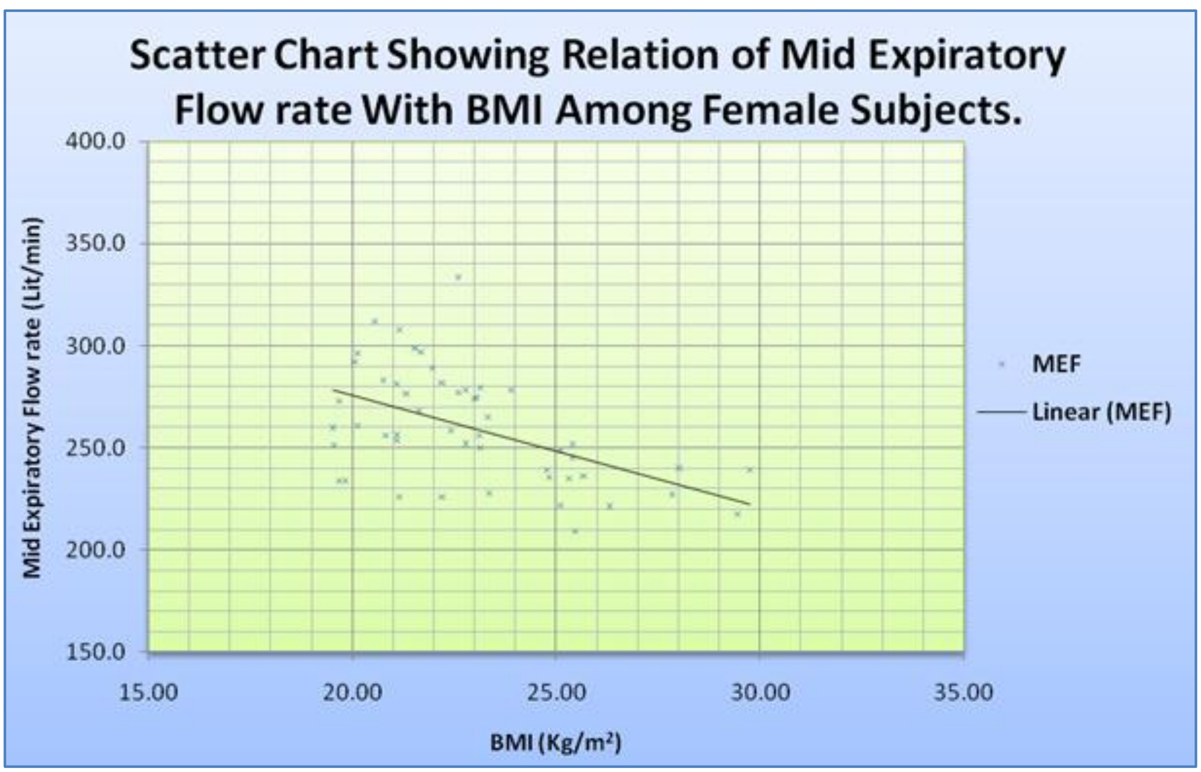

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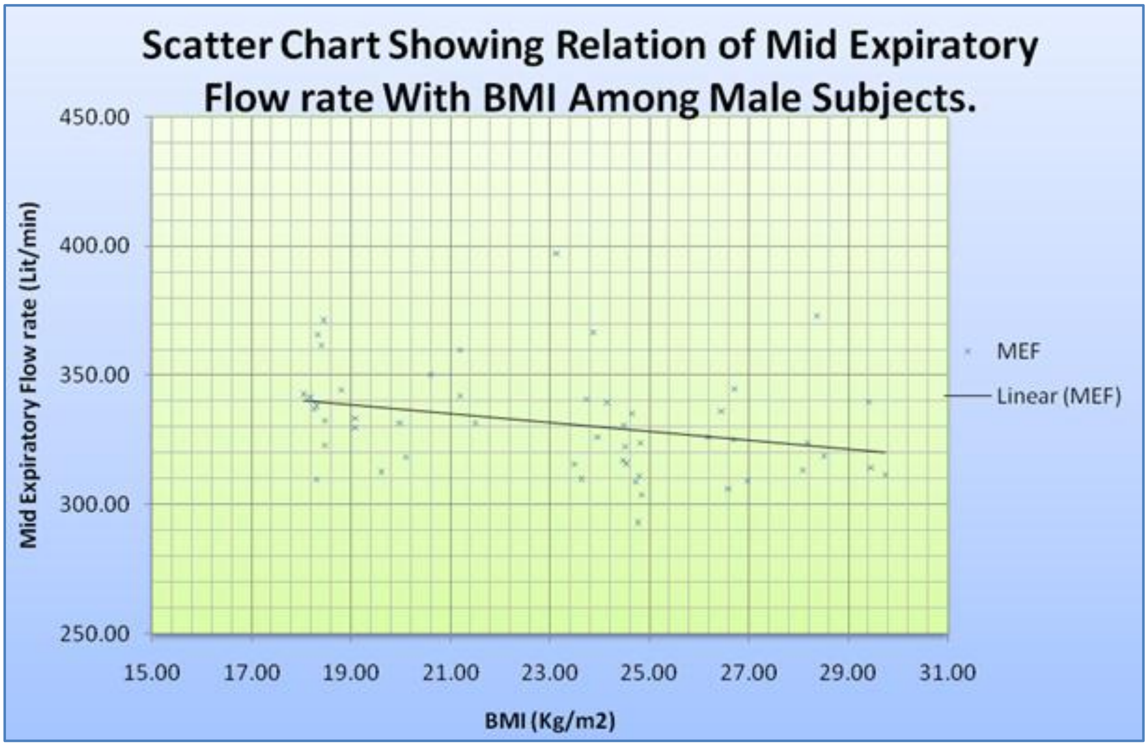

CLASSIFICATION	BMI (Kg/m²)	RISK OF CO-MORBIDITIES
UNDER – WEIGHT	<18	LOW (RISK OF OTHER CLINICAL PROBLEMD INCREASED)
NORMAL RANGE	18.5 – 22.9	AVERAGE
OVERWEIGHT	≥ 23	
PRE OBESE	23-24.9	INCREASED
CLASS I (Obese – I)	25 – 29.9	MODERATE
CLASS II (Obese – II)	≥ 30	SEVERE

ANNEXURE-I

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