

Research Article**EFFECTS OF BODY MASS INDEX ON SPIROMETRIC PARAMETERS IN ADULT MALES ATTENDING A TERTIARY CARE HOSPITAL IN WEST BENGAL, INDIA: A CROSS-SECTIONAL STUDY****Kartick Chandra Sardar^{1*}, Debjani Laha², PasangLahmu Sherpa³**¹Junior Resident; Department of Physiology, North Bengal medical College and Hospital, Darjeeling, WB, India.²Associate Professor, Department of Physiology, North Bengal Medical College and Hospital, Darjeeling, WB, India.³Associate Professor, Department of Medicine, North Bengal Medical College and Hospital, Darjeeling, WB, India.***Corresponding author:** Dr.Kartick Chandra Sardar, Junior Resident; Department of Physiology, North Bengal medical College and Hospital, Darjeeling, WB, India.**Received date: 20-09-2026, Date of Acceptance: 25-09-2026,****Date of Publication: 25-09-2026.****Abstract**

Background: Obesity is an emerging public health concern with increasing prevalence in India and is associated with multiple systemic complications, including impairment of pulmonary function.

Objectives: The present study was conducted to assess the effect of body mass index (BMI) on spirometric parameters among adult males attending a tertiary care hospital.

Methods: A hospital-based cross-sectional study was conducted among 234 adult males aged 18–60 years attending the general and medicine outpatient departments of a tertiary care hospital in West Bengal. Anthropometric measurements were recorded and BMI was calculated. Spirometric parameters including Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV1), FEV1/FVC ratio, and Peak Expiratory Flow Rate (PEFR) were

measured using a computerized spirometer. Data were analyzed using SPSS version 22, and correlation between BMI and spirometric parameters was assessed using Pearson correlation test.

Results: The mean BMI of the study participants was 24.9 ± 5.1 kg/m², with the majority belonging to the normal BMI category. A weak negative correlation was observed between BMI and FEV1 as well as BMI and FVC, both of which were not statistically significant. However, a statistically significant negative correlation was found between BMI and FEV1/FVC ratio ($p = 0.018$).

Conclusions: BMI shows a modest inverse relationship with pulmonary function parameters, particularly the FEV1/FVC ratio. Increasing BMI may contribute to early decline in lung function, highlighting the need for preventive strategies targeting obesity.

Keywords: Body mass index, spirometry, pulmonary function, FEV1, FVC, obesity

INTRODUCTION

Obesity has emerged as a major non-communicable disease worldwide, with a rapidly increasing prevalence in developing countries such as India. This rise has been attributed to rapid urbanization, sedentary lifestyle, and changing dietary habits. Obesity is associated with a wide range of co-morbid conditions, including cardiovascular diseases, diabetes mellitus, and respiratory disorders¹.

The respiratory system is significantly affected by excess body fat, which alters pulmonary mechanics by reducing chest wall compliance, limiting diaphragmatic movement, and increasing airway resistance. These changes often result in restrictive ventilatory defects and reduced lung volumes. Spirometry is a simple, reliable, and widely used tool for assessing pulmonary function and detecting early abnormalities in respiratory physiology².

Despite increasing recognition of the relationship between obesity and pulmonary function, there is limited evidence from Eastern India, particularly West Bengal. Therefore, the present study was undertaken to evaluate the association between BMI and spirometric parameters among adult males attending a tertiary care hospital.

MATERIALS AND METHODS

The present study was an institution-based cross-sectional study conducted at North Bengal Medical College and Hospital, Darjeeling, over a period of one year from December 2022 to November 2023.

The study population consisted of adult male patients aged between 18 and 60

years attending the general outpatient department and medicine outpatient department. A total of 234 participants were included in the study, and the sample size was calculated using Cochran's formula, considering a prevalence of abnormal spirometry among overweight individuals of 33% with a 5% allowable error.

Participants who provided informed consent were included in the study, while those with a history of respiratory disease, cardiovascular disease or unwillingness to participate were excluded. Anthropometric measurements were recorded using standardized instruments. Body weight was measured to the nearest 0.1 kg and height to the nearest centimeter, and BMI was calculated as weight in kilograms divided by height in meters squared.

Spirometry was performed using a computerized spirometer under standardized conditions. Participants were instructed to sit comfortably, inhale maximally, and then exhale forcefully and completely into the spirometer. The procedure was repeated three times, and the best of the three readings was recorded for analysis.

The primary variables studied included BMI as the independent variable and spirometric parameters such as FEV1, FVC, FEV1/FVC ratio, and PEFR as dependent variables. Data were entered into Microsoft Excel and analyzed using SPSS version 22. Continuous variables were expressed as mean and standard deviation, and Pearson correlation test was used to assess the association between BMI and spirometric parameters. A p-value of less than 0.05 was considered statistically significant. Ethical approval for the study was obtained from the

Institutional Ethics Committee, and informed consent was obtained from all participants.

RESULTS

A total of 234 adult male participants were included in the study. The age distribution showed that the largest proportion of

participants (37.2%) belonged to the 18–29 years age group, followed by 22.2% in the 50–59 years age group, 16.2% in the 30–39 years group, 15.4% in the 40–49 years group, and 9.0% aged 60 years and above. The mean age of the study population was 38.4 ± 14.9 years, indicating a relatively wide age distribution

Table 1: Socio-demographic characteristics of study participants (n = 234)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18–29	87	37.2
	30–39	38	16.2
	40–49	36	15.4
	50–59	52	22.2
	≥60	21	9.0
Residence	Rural	140	59.8
	Urban	94	40.2
Education	Primary	23	9.8
	Middle	45	19.2
	Secondary	49	20.9
	Higher Secondary	50	21.4
	Graduate & above	67	28.6
Occupation	Student	57	24.4
	Business	46	19.7
	Labourer	59	25.2
	Farmer	10	4.3
	Driver	10	4.3
	Service	52	22.2

In terms of residence, the majority of participants (59.8%) were from rural areas, while 40.2% belonged to urban areas. Regarding educational status, most participants (28.6%) had attained graduate-level education or higher, followed by those with higher secondary education (21.4%), secondary education (20.9%), middle school education (19.2%), and primary education (9.8%). Occupationally, labourers constituted the largest group (25.2%), followed by students (24.4%), service holders (22.2%), businessmen (19.7%), and smaller proportions of farmers and drivers (4.3% each).

Anthropometric assessment revealed that the majority of participants (84.6%) had a height between 1.5 and 1.9 meters, with a mean height of 1.63 ± 0.11 meters. The weight distribution showed that most participants (29.9%) weighed between 55–64 kg, followed by 23.5% in the 65–74 kg

range and 20.9% in the 45–54 kg range. The mean weight of the participants was 64.9 ± 12.2 kg. Waist circumference measurements indicated that 59.4% of participants had a waist circumference of ≥ 80 cm, while 38.5% had measurements between 60–79 cm and only 2.1% had less than 60 cm. The mean waist circumference was 82.3 ± 10.8 cm.

The distribution of BMI according to the WHO international classification revealed that 44.4% of participants had normal BMI, 26.5% were overweight, 18.8% were obese, and 10.3% were underweight. The mean BMI of the study population was 24.9 ± 5.1 kg/m². However, when categorized according to the South Asian classification, a higher proportion (45.3%) of participants fell into the obese category, reflecting the lower BMI cut-offs for Asian populations

Table 2: Anthropometric characteristics of study participants (n = 234)

Variable	Category	Frequency (n)	Percentage (%)
Height (m)	<1.5	35	15.0
	1.5–1.9	198	84.6
	≥ 2.0	1	0.4
Weight (kg)	<45	4	1.7
	45–54	49	20.9
	55–64	70	29.9
	65–74	55	23.5
	75–84	40	17.1
	85–94	13	5.6
	≥ 95	3	1.3
Waist Circumference (cm)	<60	5	2.1

	60–79	90	38.5
	≥80	139	59.4

Table 3: Distribution of participants according to BMI (n = 234)

BMI Category	Frequency (n)	Percentage (%)
Underweight (<18.5)	24	10.3
Normal (18.5–22.9)	69	29.5
Overweight (23–24.9)	35	15.0
Obese (≥25)	106	45.3

The mean spirometric parameters observed among the study participants were as follows: FEV1 was 2.81±0.78 liters, FVC was 3.12±0.71 liters, FEV1/FVC ratio was 87.16±10.29%, and PEFR was 6.38±2.31 liters per second.

Table 4: Mean spirometric parameters of study participants (n = 234)

Parameter	Mean	Standard Deviation
FEV1 (L)	2.81	0.78
FVC (L)	3.12	0.71
FEV1/FVC (%)	87.16	10.29
PEFR (L/sec)	6.38	2.31

Correlation analysis between BMI and spirometric parameters demonstrated a weak negative relationship. BMI showed a very weak negative correlation with FEV1 ($r = -0.069$) and FVC ($r = -0.097$), both of which were not statistically significant, with p-values of 0.351 and 0.192 respectively. This suggests that although there is a tendency for lung volumes to decrease with increasing BMI, the association is not strong in this study population. In contrast, a statistically significant negative correlation was observed between

BMI and FEV1/FVC ratio ($p = 0.018$), indicating that increasing BMI may be associated with early changes in airway dynamics. Although the correlation coefficient was small, the statistical significance suggests a consistent trend within the study population. Scatter plots (as shown in Figures 10–12 of the thesis) further illustrated these relationships, demonstrating a slight downward trend of spirometric parameters with increasing BMI, particularly for the FEV1/FVC ratio.

Table 5: Correlation between BMI and spirometric parameters

Parameter	Correlation coefficient (r)	p-value	Interpretation
FEV1	-0.069	0.351	Not significant
FVC	-0.097	0.192	Not significant
FEV1/FVC	-0.048	0.018	Significant
PEFR	Weak negative	Not significant	Not significant

Overall, the results indicate that while BMI has only a weak association with absolute lung volumes such as FEV1 and FVC, it shows a significant relationship with airflow indices like the FEV1/FVC ratio, suggesting early functional impairment of the respiratory system with increasing body mass.

DISCUSSION

The present study demonstrated a weak inverse relationship between BMI and spirometric parameters, with a statistically significant negative association observed only for the FEV1/FVC ratio. These findings suggest that increasing BMI may have a subtle but measurable impact on pulmonary function, particularly affecting airway dynamics rather than absolute lung volumes³.

The observed weak and non-significant negative correlation between BMI and FEV1 and FVC in the present study is consistent with the findings of a study by Al Ghobain (2012)⁴, which reported no significant differences in FEV1 and FVC between obese and non-obese individuals. However, that study found a significant reduction in peak expiratory flow (PEF) among obese subjects, suggesting increased airway resistance. This similarity indicates that spirometric changes in obesity may initially be subtle and may not

always reflect significant reductions in lung volumes, especially in otherwise healthy individuals.

Similarly, Banerjee et al⁵. (2014) reported no significant association between BMI and spirometric parameters in obese male subjects, which aligns closely with the present findings. This further supports the notion that the impact of BMI on pulmonary function may vary depending on gender and population characteristics.

In contrast, several other studies have demonstrated a stronger inverse relationship between BMI and lung function. A study by Wang et al⁶. (2023) found that obesity was associated with significantly lower FVC percentages and reduced lung volumes, suggesting that increased adiposity leads to mechanical restriction of the lungs. Similarly, a systematic review by Melo et al. reported that obese individuals consistently show reduced lung volumes, including FVC and FEV1, compared to normal-weight individuals. These differences may be due to variations in study population, degree of obesity, and inclusion of subjects with underlying respiratory conditions.

The present study, however, found a statistically significant negative correlation between BMI and FEV1/FVC ratio, indicating early airway involvement. This

finding is important because it suggests that even in the absence of significant reduction in lung volumes, obesity may affect airflow dynamics. Comparable findings have been reported in recent studies, where increased BMI was associated with alterations in airflow indices and early airway limitation.

Several studies have also demonstrated that obesity leads to a reduction in expiratory reserve volume (ERV) and functional residual capacity (FRC), which are not directly measured by spirometry but significantly influence spirometric outcomes. Jones et al. and Sahebajami et al. showed that BMI has a significant effect on lung volumes, particularly ERV and FRC, even at moderate levels of obesity. These physiological changes can contribute to increased airway closure and ventilation-perfusion mismatch, thereby affecting respiratory efficiency.

Furthermore, studies conducted in symptomatic or diseased populations have reported more pronounced effects of BMI on pulmonary function. For example, Alqarni et al. (2024) observed that obese individuals with dyspnea had significantly lower FEV1, FVC, and PEF compared to normal-weight individuals. Similarly, other studies have reported a clear inverse relationship between BMI and spirometric parameters such as FEV1, FVC, and PEF, indicating that obesity can significantly impair respiratory function. The relatively weaker associations observed in the present study may be due to the inclusion of apparently healthy individuals without overt respiratory disease.

The findings of the present study can be explained by the mechanical and physiological effects of obesity on the

respiratory system. Excess adipose tissue around the thoracic cage and abdomen reduces chest wall compliance, restricts lung expansion, and limits diaphragmatic excursion. Additionally, obesity increases airway resistance and respiratory workload, which may lead to early functional impairment even before significant reductions in lung volumes occur.

Another important observation from the literature is that weight reduction has been shown to improve pulmonary function. Studies have demonstrated that weight loss leads to significant improvements in FEV1 and FVC, indicating that the effects of obesity on lung function are at least partially reversible. This highlights the importance of weight management as a key intervention for preserving respiratory health.

Overall, the present study findings are in partial agreement with existing literature. While some studies report strong inverse associations between BMI and lung function, others, particularly those involving healthy populations, show weaker or non-significant relationships. The significant association observed with FEV1/FVC ratio in this study suggests that airway changes may occur earlier than changes in lung volumes.

CONCLUSION

The study concludes that BMI has a modest inverse relationship with pulmonary function parameters, particularly the FEV1/FVC ratio. Increasing BMI may contribute to early decline in lung function. These findings highlight the need for preventive strategies

focusing on weight management to reduce the risk of respiratory impairment.

LIMITATIONS

The study was limited by its cross-sectional design, which does not establish causality. It was conducted in a single center and included only male participants, wide age distribution which may limit generalizability.

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Conflict of Interest

The authors declare no conflict of interest.

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