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A COMPARATIVE STUDY OF PULMONARY FUNCTION PARAMETERS IN OBESE AND NON-OBESE YOUNG ADULTS

Dr. Kumari Rekha[1], Dr. Asfa Ahmad[2]*, Dr. Suhash Tetarway[3], Dr. Vijay Kumar[4]

[1] Assistant Professor, Department of Physiology, Laxmi Chandravansi Medical College and Hospital, Palamu, India
[2] *Assistant Professor, Department of Physiology, Laxmi Chandravansi Medical College and Hospital, Palamu, India
[3] Professor, Department of Physiology, Laxmi Chandravansi Medical College and Hospital, Palamu, India
[4] Professor, Department of Community Medicine, Laxmi Chandravansi Medical College and Hospital, Palamu, India

***Corresponding Author-** Dr. Asfa Ahmad
*Assistant Professor, Department of Physiology, Laxmi Chandravansi Medical College and Hospital, Palamu, India

Abstract-

Introduction- Obesity is a growing public health concern associated with cardiovascular, metabolic, and respiratory disorders. Excess adiposity impairs lung mechanics, reducing spirometric parameters such as forced vital capacity (FVC) and forced expiratory volume in one second (FEV_1). Young adults are particularly vulnerable, yet comparative data on pulmonary function in obese and non-obese individuals remain limited.

Material and Method- This comparative cross-sectional study included 100 healthy young adults (50 obese, 50 non-obese) aged 18–25 years. Anthropometric measurements, baseline physiological parameters, and spirometric assessments (FVC, FEV_1, FEV_1/FVC, peak expiratory flow rate [PEFR], and forced expiratory flow at 25–75% of FVC [$FEF_{25–75}$%]) were recorded. Data were analyzed using SPSS; Student's t-test compared groups, and Pearson's correlation assessed associations, with $p < 0.05$ considered significant.

Result- Obese participants had significantly higher weight, Body mass index (BMI), waist-hip ratio, and resting cardio-respiratory parameters. Pulmonary function parameters (FVC, FEV_1, PEFR, $FEF_{25–75}$%) were significantly lower in obese individuals, while FEV_1/FVC ratio remained unchanged. BMI showed significant negative correlations with lung volumes and expiratory flows, indicating a restrictive pulmonary pattern in obesity.

Conclusion- Obesity in young adults is associated with reduced lung volumes and expiratory flow, elevated cardio-respiratory parameters, and a restrictive pulmonary pattern. BMI inversely correlates with pulmonary function, highlighting the need for early weight management and preventive interventions.

Keywords- Obesity, pulmonary function, young adults, body mass index (BMI), spirometry etc.

Introduction-

Obesity has emerged as a major global public health concern, with a rapidly increasing prevalence among adolescents and young adults. The World Health Organization identifies obesity as a

significant risk factor for non-communicable diseases, including cardiovascular, metabolic, and respiratory disorders [1]. The early onset of obesity is particularly concerning, as it may lead to long-term physiological alterations and increased disease burden later in life. While the metabolic consequences of obesity have been extensively studied, its effects on pulmonary function, especially in young adults, require further exploration. Excess adiposity influences respiratory mechanics through both mechanical and inflammatory pathways. Increased fat deposition over the chest wall and abdomen reduces thoracic compliance and limits diaphragmatic movement, resulting in altered lung volumes and airflow dynamics [2,3]. These mechanical constraints may lead to reductions in forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), and peak expiratory flow rate, even in individuals without clinically apparent respiratory disease [4]. Pulmonary function tests (PFTs), particularly spirometry, are widely used to objectively assess these changes and provide early indicators of respiratory impairment.

Young adulthood represents a critical period when lung function reaches its peak before gradually declining with age. Any functional compromise during this stage may have long-term implications for respiratory health [5]. Recent studies have demonstrated a significant association between higher body mass index (BMI) and reduced spirometric parameters in young and middle-aged adults, suggesting that obesity may induce early restrictive ventilatory changes [6,7]. However, findings across studies are not entirely consistent, with some reporting preserved FEV_1/FVC ratios despite reduced lung volumes, highlighting the need for further comparative research. The impact of obesity on pulmonary function may also vary across populations due to differences in ethnicity, body fat distribution, and lifestyle factors. South Asian populations, including Indians, tend to have higher body fat percentages at lower BMI levels, which may predispose them to greater physiological compromise [8]. Despite the rising prevalence of obesity among Indian young adults, especially students and urban populations, recent region-specific data comparing pulmonary function between obese and non-obese individuals remain limited. Given the increasing prevalence of obesity among young adults and the potential for early, subclinical respiratory impairment, it is essential to evaluate pulmonary function parameters in this population. Comparative assessment of spirometric indices between obese and non-obese young adults can provide valuable insights into the early physiological effects of obesity on lung function. Such evidence may aid in early risk identification, reinforce the importance of lifestyle modification, and contribute to preventive strategies aimed at preserving long-term respiratory health.

Material and Method-

This comparative cross-sectional study was conducted in the Department of Physiology of Laxmi Chandravansi Medical College and Hospital, Bishrampur, Palamu over a period of six months from January 2025 to June 2025. The study aimed to compare pulmonary function parameters between obese and non-obese young adults using standardized spirometric measurements. The study population comprised apparently healthy young adults aged 18–25 years. A total sample size of 100 participants was included, divided equally into two groups: 50 obese and 50 non-obese individuals. The sample size was determined based on previous studies reporting significant differences in spirometric parameters between obese and non-obese subjects, with a confidence level of 95% and power of 80%. The study protocol was approved by the Institutional Ethics Committee. Informed consent was obtained from all the participants and they were recruited using a convenient sampling technique after explaining the purpose, procedures, and potential benefits of the study. Individuals with a history of smoking, chronic respiratory diseases (such as asthma or chronic obstructive pulmonary disease), cardiovascular disorders, recent respiratory tract infections (within the last four weeks), musculoskeletal deformities of the chest wall, or those on medications affecting respiratory function were excluded from the study

Participants were categorized as obese and non-obese based on their body mass index (BMI). Individuals with BMI ≥25 kg/m² were categorized as obese, while those with BMI between 18.5 and 22.9 kg/m² were considered non-obese, as per Asia-Pacific BMI guidelines. BMI was calculated as weight in kilograms divided by height in meters squared (kg/m²). Height was measured using a

stadiometer to the nearest 0.1 cm, and body weight was recorded using a calibrated digital weighing scale to the nearest 0.1 kg. Pulmonary function tests were performed using a computerized spirometer following the American Thoracic Society/European Respiratory Society guidelines. The parameters assessed included forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), FEV_1/FVC ratio, and peak expiratory flow rate (PEFR). Forced expiratory flow between 25% and 75% of FVC ($FEF_{25–75}$%) was also measured. Each participant performed at least three acceptable and reproducible maneuvers in a seated position, and the best of the three readings was recorded for analysis. In addition to these parameters, waist and hip circumference were recorded. Baseline physiological parameters such as respiratory rate, heart rate, blood pressure, and peripheral oxygen saturation (SpO_2 %) at rest were measured. Data were entered and analyzed using Statistical Package for Social Sciences (SPSS) software version 25.0. Categorical variables were expressed as numbers and percentages, while continuous and quantitative variables were expressed as mean ± standard deviation. The relationship between BMI and pulmonary function parameters was analyzed using Pearson's correlation. Independent Student's t-test was used to compare pulmonary function parameters between obese and non-obese groups. A p-value of <0.05 was considered statistically significant.

Result-

A total of 100 young adults were included in the study, with 50 participants in each of the obese and non-obese groups. The demographic characteristics of the study population are summarized in Table 1. The mean age of participants in the obese group was 21.4 ± 1.9 years, compared to 21.1 ± 2.0 years in the non-obese group, with no statistically significant difference observed (p = 0.42). Age-group distribution was similar between the two groups as seen in Figure 1. In the 18–20 years category, 15 (30%) participants in the obese group and 17 (34%) in the non-obese group were included. The majority of participants belonged to the 21–23 years age group, comprising 22 (44%) in the obese group and 20 (40%) in the non-obese group, while 13 (26%) participants in each group were aged 24–25 years. No significant difference in age-group distribution was noted (p = 0.87). Regarding sex distribution, males accounted for 26 (52%) participants in the obese group and 25 (50%) in the non-obese group, whereas females comprised 24 (48%) and 25 (50%), respectively. The difference in sex distribution between the two groups was not statistically significant (p = 0.84). These findings indicate that the two groups were well-matched in terms of age and sex, ensuring comparability for further analysis of anthropometric and pulmonary function parameters.

Table 1- Demographic characteristics of participants

Age		**Obese (n=50)**	**Non-Obese (n=50)**	**p- value**
Age (Mean ± SD in years)		21.4 ± 1.9	21.1 ± 2.0	0.42
Age group in years n (%)	18–20	15 (30%)	17 (34%)	0.87
	21–23	22 (44%)	20 (40%)	
	24–25	13 (26%)	13 (26%)	
Sex	Male	26 (52%)	25 (50%)	0.84
	Female	24 (48%)	25 (50%)	

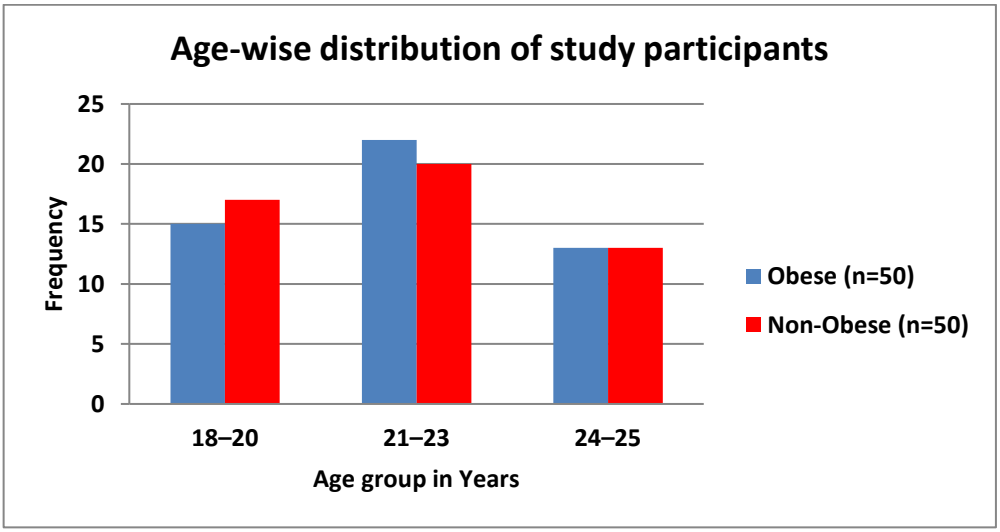

Figure 1- Age-wise distribution of study participants

The anthropometric characteristics of the study participants are presented in Table 2. Height was similar in both groups (165.3 ± 7.4 cm vs 166.1 ± 6.9 cm, p = 0.56). Significant differences were observed in parameters related to body weight and adiposity. The mean weight was significantly higher in the obese group (78.6 ± 8.9 kg) compared to the non-obese group (58.2 ± 6.4 kg, p < 0.001). Correspondingly, the mean body mass index was markedly higher in obese participants (28.7 ± 2.6 kg/m²) than in non-obese participants (21.3 ± 1.1 kg/m², p < 0.001). Central and peripheral adiposity measures also differed significantly between the groups. The obese group had higher waist circumference (96.4 ± 7.8 cm vs 78.6 ± 6.3 cm, p < 0.001), hip circumference (104.2 ± 6.9 cm vs 94.1 ± 5.8 cm, p < 0.001), and waist-hip ratio (0.92 ± 0.05 vs 0.84 ± 0.04, p < 0.001) compared to the non-obese group. These findings confirm the expected differences in body composition between obese and non-obese young adults, highlighting the distinct anthropometric profiles that could influence pulmonary function in subsequent analyses.

Table 2- Anthropometric characteristics of participants

Parameter	Obese (n = 50)	Non-Obese (n = 50)	p-value
Height (cm)	165.3 ± 7.4	166.1 ± 6.9	0.56
Weight (kg)	78.6 ± 8.9	58.2 ± 6.4	**<0.001**
Body Mass Index (kg/m²)	28.7 ± 2.6	21.3 ± 1.1	**<0.001**
Waist Circumference (cm)	96.4 ± 7.8	78.6 ± 6.3	**<0.001**
Hip Circumference (cm)	104.2 ± 6.9	94.1 ± 5.8	**<0.001**
Waist-Hip Ratio	0.92 ± 0.05	0.84 ± 0.04	**<0.001**

The baseline physiological parameters of the study participants are summarized in Table 3. The obese group exhibited significantly higher values in all measured parameters compared to the non-obese group. The mean respiratory rate was elevated in obese participants (18.6 ± 2.1 breaths/min) compared to non-obese participants (16.9 ± 1.8 breaths/min, p < 0.001). Similarly, heart rate was higher in the obese group (78.4 ± 6.7 beats/min) than in the non-obese group (72.6 ± 5.9 beats/min, p < 0.001). Blood pressure also showed a significant difference between groups. The mean systolic blood pressure was 122.8 ± 9.6 mmHg in the obese group and 114.5 ± 8.7 mmHg in the non-obese group (p < 0.001), while the diastolic blood pressure was 78.9 ± 6.4 mmHg versus 73.8 ± 5.6 mmHg, respectively (p < 0.001). Peripheral oxygen saturation (SpO_2) was slightly lower in obese participants (97.1 ± 1.2%) compared to non-obese participants (98.3 ± 0.9%, p < 0.001). These findings indicate that obesity in young adults is associated with elevated resting cardiorespiratory parameters and slightly reduced

oxygen saturation, which may have implications for pulmonary function and overall cardiopulmonary health.

Table 3- Baseline physiological parameters in obese and non-obese groups

Parameter	Obese (n = 50)	Non-Obese (n = 50)	p-value
Respiratory Rate (breaths/min)	18.6 ± 2.1	16.9 ± 1.8	**<0.001**
Heart Rate (beats/min)	78.4 ± 6.7	72.6 ± 5.9	**<0.001**
Systolic BP (mmHg)	122.8 ± 9.6	114.5 ± 8.7	**<0.001**
Diastolic BP (mmHg)	78.9 ± 6.4	73.8 ± 5.6	**<0.001**
SpO_2 (%)	97.1 ± 1.2	98.3 ± 0.9	**<0.001**

The comparison of pulmonary function parameters between obese and non-obese young adults is presented in Table 4. The obese group demonstrated significantly lower values in most pulmonary function parameters compared to the non-obese group. The mean forced vital capacity (FVC) was 3.12 ± 0.48 L in obese participants versus 3.58 ± 0.52 L in non-obese participants ($p < 0.001$). Similarly, FEV_1 was reduced in the obese group (2.61 ± 0.41 L) compared to the non-obese group (3.02 ± 0.46 L, $p < 0.001$). Peak expiratory flow rate (PEFR) and forced expiratory flow at 25–75% of FVC ($FEF_{25–75}$%) were also significantly lower in obese participants (398.6 ± 52.4 L/min vs 452.1 ± 56.7 L/min, $p < 0.001$; and 2.41 ± 0.46 L/s vs 2.89 ± 0.51 L/s, $p < 0.001$, respectively). In contrast, the FEV_1/FVC ratio was comparable between the two groups (83.6 ± 5.2% vs 84.4 ± 4.9%, $p = 0.41$). These findings suggest a restrictive pattern of pulmonary function in obese young adults, with significantly reduced lung volumes and flow rates, while the ratio of FEV_1 to FVC remains preserved. This pattern highlights impact of excess body weight on ventilatory mechanics and airway function.

Table 4- Comparison of pulmonary function between obese and non-obese young adults

Pulmonary Function Parameter	Obese (n = 50)	Non-Obese (n = 50)	p-value
Forced Vital Capacity (FVC) (L)	3.12 ± 0.48	3.58 ± 0.52	**<0.001**
FEV_1 (L)	2.61 ± 0.41	3.02 ± 0.46	**<0.001**
FEV_1/FVC (%)	83.6 ± 5.2	84.4 ± 4.9	0.41
PEFR (L/min)	398.6 ± 52.4	452.1 ± 56.7	**<0.001**
$FEF_{25–75}$% (L/s)	2.41 ± 0.46	2.89 ± 0.51	**<0.001**

The relationship between body mass index (BMI) and pulmonary function parameters was analyzed using Pearson's correlation as seen in Table 5. BMI showed a significant negative correlation with forced vital capacity (FVC, $r = –0.42$, $p < 0.001$), forced expiratory volume in one second (FEV_1, $r = –0.38$, $p < 0.001$), peak expiratory flow rate (PEFR, $r = –0.35$, $p < 0.001$), and forced expiratory flow at 25–75% of FVC ($FEF_{25–75}$%, $r = –0.33$, $p < 0.001$). No significant correlation was observed between BMI and the FEV_1/FVC ratio ($r = –0.08$, $p = 0.42$). These findings indicate that increasing BMI is associated with reduced lung volumes and expiratory flow rates, while the relative proportion of FEV_1 to FVC remains unaffected.

Table 5- Correlation of BMI with pulmonary function parameters

Pulmonary Function Parameter	Pearson r	p-value
FVC	–0.42	**<0.001**
FEV_1	–0.38	**<0.001**
FEV_1/FVC	–0.08	0.42
PEFR	–0.35	**<0.001**
$FEF_{25–75}$%	–0.33	**<0.001**

Discussion-

The present study investigated the impact of obesity on pulmonary function parameters in young adults and examined the correlation between body mass index (BMI) and lung function. Our findings indicate that obese participants had significantly higher anthropometric indices, elevated resting cardiorespiratory parameters, and reduced pulmonary function compared to non-obese individuals. These results highlight the physiological implications of obesity even in young adults and underscore the importance of early interventions. In terms of anthropometric characteristics, the obese group demonstrated significantly higher weight, BMI, waist circumference, hip circumference, and waist-hip ratio. These findings are supported by the study of Babb et al. [11], which reported increased central and peripheral adiposity in obese young adults. Similarly, Salome et al. [12] observed that excess adiposity alters respiratory mechanics, potentially contributing to reductions in lung volumes. In contrast, Jones et al. [13] reported minimal differences in waist-hip ratio between obese and non-obese participants, possibly due to variations in sample selection, age, and ethnicity. Our study also revealed that obese participants had elevated resting physiological parameters, including respiratory rate, heart rate, and blood pressure, along with slightly reduced peripheral oxygen saturation. These findings are consistent with Chandra et al. [14], who demonstrated that obesity in young adults is associated with increased metabolic demand and sympathetic activity, resulting in higher baseline cardiorespiratory measures. In contrast, Kim et al. [15] reported only modest differences in heart rate and blood pressure between obese and non-obese groups, which may reflect lower degrees of obesity in their study population.

Analysis of pulmonary function revealed that obese participants had significantly lower forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), peak expiratory flow rate (PEFR), and forced expiratory flow at 25–75% of FVC ($FEF_{25–75}$%), whereas the FEV_1/FVC ratio remained comparable between groups. These results are supported by Lazarus et al. [16], who reported a restrictive ventilatory pattern in obese adults characterized by reduced lung volumes but preserved FEV_1/FVC ratio. Similarly, Lunt et al. [17] documented reductions in FVC and FEV_1 in obese individuals, attributing the decline to mechanical effects of excess adipose tissue on chest wall compliance and diaphragmatic movement. In contrast, Garcia-Rio et al. [18] observed reductions in both FEV_1 and FEV_1/FVC ratio in severely obese subjects, suggesting the development of obstructive components in extreme obesity. Differences in BMI thresholds and severity of obesity may account for these variations. Correlation analysis in our study revealed significant negative associations between BMI and FVC, FEV_1, PEFR, and $FEF_{25–75}$%, indicating that higher BMI is linked to diminished lung volumes and expiratory flows. This observation is supported by Ray et al. [19], who also reported inverse correlations between BMI and pulmonary function, emphasizing the adverse impact of obesity on ventilatory capacity. In contrast, Smith et al. [20] found no significant correlation between BMI and PEFR, possibly due to differences in spirometry techniques or physical activity levels among participants. Overall, our findings confirm that obesity in young adults is associated with altered anthropometry, elevated resting cardiorespiratory parameters, and reduced pulmonary function, particularly in terms of lung volumes and expiratory flow rates. These results underscore the importance of weight management interventions in preventing early pulmonary impairment and maintaining optimal respiratory health.

Conclusion-

The present study demonstrates that obesity in young adults is associated with significant alterations in pulmonary function. Compared to non-obese peers, obese participants exhibited reduced lung volumes and expiratory flow rates, as evidenced by lower forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), peak expiratory flow rate (PEFR), and forced expiratory flow at 25–75% of FVC ($FEF_{25–75}$%), while the FEV_1/FVC ratio remained unaffected. These findings suggest a predominantly restrictive pattern of lung function in obese young adults, likely due to the mechanical impact of excess adipose tissue on chest wall compliance and diaphragmatic excursion. Furthermore, BMI was inversely correlated with key pulmonary function parameters, emphasizing the dose-dependent relationship between body weight and ventilatory capacity. The study also

confirmed that obesity is linked with elevated resting physiological parameters, including heart rate, blood pressure, and respiratory rate, as well as a slight reduction in oxygen saturation, highlighting the broader cardiopulmonary implications of excess body weight even in a young, otherwise healthy population. Early identification and management of obesity in young adults could prevent the progression of restrictive pulmonary changes and associated cardiovascular strain. Routine assessment of pulmonary function in obese individuals may aid in early detection of ventilatory compromise. Additionally, these results reinforce the importance of public health initiatives aimed at promoting healthy body weight through lifestyle modification, physical activity, and nutritional interventions.

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Conflict of interest- None

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