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Original Research Article

TO COMPARE PULMONARY FUNCTION AND CLINICAL CHARACTERISTICS BETWEEN OBESE AND NON-OBESE BRONCHIAL ASTHMA PATIENTS

Shaminder Singh[1], Kamaldeep Singh[2], Vidhu mittal[3], Surinderpal Singh[4], Staphy Garg[5]

[1]Junior Resident, Department of Pulmonary Medicine, Government Medical College, Patiala, India.
[2]Senior Resident, Department of Pulmonary Medicine Department, Government Medical College, Patiala, India.
[3] Medical Officer, Department of Pulmonary Medicine, Government Medical College, Patiala, India.
[4]Professor, Department of Pulmonary Medicine, Government Medical College, Patiala, India.
[5]Junior Resident, Department of Pulmonary Medicine, Government Medical College, Patiala, India.

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Corresponding Author:
Dr. Surinder Pal Singh,
Email: drsurinderpal09@gmail.com

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Abstract

Background: Asthma is a diverse, inflammatory condition affecting the airways. It is characterised by increased sensitivity of the airways, resulting in repeated occurrences of wheezing, difficulty breathing, chest constriction, and coughing, often during night time or early morning hours. **Aim:** To examine pulmonary function and clinical characteristics, and compare them between obese and non-obese patients with bronchial asthma. **Material & Methods:** A cohort of 100 participants, consisting of 50 obese and 50 non-obese people with asthma. This research included all adult individuals with asthma who were classified as obese, including those at risk, according to the World Health Organisation. The information required includes demographic data, historical background, clinical examination findings, and specific details on investigations such as Pulmonary function test, Complete hemogram, Chest X-ray and Electrocardiogram. **Results:** The average BMI of the patients in the obese group was 31.25±3.28 kilogrammes per square metre, whereas in the non-obesity group it was 21.24±1.25 kg/m2. The average Forced Expiratory Volume in 1st second (FEV1) and Forced Vital Capacity (FVC) in obese asthmatics are 1.21±0.14 l/s and 1.71±0.44 l/s, respectively. In non-obese individuals, the average FEV1 is 1.61+0.41 l/s and the average FVC is 2.91+0.28 l/s. In this research, the average value of FEF 25-75% in obese asthmatics is 1.29+0.29 l/s, whereas in non-obese individuals it is 1.64+0.19 l/s. In our research, we also examined the average value of FEV1/FVC % for both the obese and non-obesity groups. The mean value for the obese group was 69.96 +6.63, whereas the mean value for the non-obese group was 66.18 ±4.25. **Conclusion:** The predominant symptoms identified in this research were dyspnea, cough, and wheezing. Obese asthmatics had a higher prevalence of diabetes mellitus and hypertension. In obese individuals with asthma, the FVC and Forced Expiratory Volume in 1 second (FEV1) are reduced. However, non-obese individuals with asthma have a greater degree of reversibility.

INTRODUCTION

Asthma is a medical condition that is characterised by inflammation of the airways, fluctuating lung function, and increased sensitivity of the airways. The prevalence of asthma rises in tandem with the adoption of western lifestyles and urbanisation in communities. Given the predicted growth of urban populations, it is expected that the global number of individuals with asthma may increase by an extra 100 million by 2025. The annual incidence of disability-adjusted life years (DALYs) attributable to asthma is around 15 million, which is comparable to the DALYs associated with diabetes, cirrhosis of the liver, or schizophrenia.[1-3]Host variables like as genetics, weight, and sex, as well as environmental factors including allergens, infections, occupational sensitizers, tobacco smoke, outdoor and indoor pollution, and food, all have a role in the development and manifestation of asthma.

Allergen-induced acute bronchoconstriction occurs when mast cells produce mediators, such as histamine, tryptase, leukotrienes, and prostaglandins, in response to IgE. These mediators directly cause the contraction of airway smooth muscle, resulting in the clinical symptoms of asthma. Chronic inflammation results in swelling of the airways, inflammation, excessive production of mucus, and the development of thickened mucus plugs. Additionally, there are structural alterations such as enlargement and increased cell division of the smooth muscles in the airways. Airway hyperresponsiveness refers to an excessive narrowing of the bronchi in response to various stimuli. The factors that contribute to airway hyperresponsiveness are many and include inflammation, impaired neuroregulation, and structural alterations. The airway can undergo permanent structural changes, such as thickening of the sub-basement membrane, sub epithelial fibrosis, hypertrophy and hyperplasia of the airway smooth muscle, proliferation and dilation of blood vessels, and hyperplasia and excessive secretion of mucous glands. These changes are linked to a gradual decline in lung function, obstruction of airflow, increased sensitivity of the airway, and reduced effectiveness of treatment.

Obesity is a significant and growing health issue globally, affecting both developed and developing nations. In India, obesity is becoming a significant health issue, especially in metropolitan areas, despite the simultaneous presence of undernutrition. The correlation between the rising incidence of obesity and asthma remains disputed.[4]The origin of obesity is complex and involves several factors. Obesity may manifest at any stage of life and often escalates with advancing age. Infants that experience rapid weight growth are more likely to develop obesity in the future. Typically, women have a greater prevalence of obesity compared to males, however men may have higher percentages of being overweight. Substantial evidence supports the notion that engaging in regular physical exercise effectively guards against the accumulation of excess weight that is detrimental to one's health. While a sedentary lifestyle, especially sedentary jobs and lack of physical activity during leisure time, encourages it. An evident adverse correlation exists between socioeconomic position and obesity. The dietary content, frequency of food consumption, and calorie intake are all significant factors in the development of obesity. A recent meta-analysis determined that there is a consistent positive association between alcohol use and obesity in males, whereas a negative association is seen in women. Obesity often has a familial pattern, however this is not primarily attributed to genetic factors. Endocrine diseases such as Cushing's syndrome and growth hormone insufficiency are often accompanied with obesity. Reports on the correlation between tobacco use and decreased body weight emerged over a century ago, but comprehensive research have just been published within the last decade. The use of certain medications, such as corticosteroids, contraceptives, and insulin, may contribute to an increase in body weight.[5]

Obesity may have several systemic consequences that might impact pulmonary function. While it is often believed that inflammation and excess fat in the trunk area contribute to changes in lung function in obese individuals, recent research suggests that metabolic abnormalities may also play a role.[6] Obesity is linked to metabolic abnormalities such as high levels of insulin in the blood (hyperinsulinemia), reduced sensitivity to insulin (insulin resistance), and abnormal levels of lipids in the blood (dyslipidemia). Children with asthma had a higher prevalence of insulin resistance and its surrogate clinical sign, acanthosis nigricans, compared to children without asthma.[7]There is a connection between dyslipidemia and wheezing, insulin resistance and the development of asthma, as well as a link between dyslipidemia and lower airway obstruction in adults. Obesity is linked to widespread inflammation in the body, which may lead to increased sensitivity of the airways, a characteristic seen in people with asthma.[8] Visceral adipose tissue is the primary contributor to the development of low-grade chronic inflammation in obese patients and is involved in the remodelling process that is typical of asthma. Individuals with visceral obesity have elevated levels of interleukin-6 (IL-6) and tumour necrosis factor-alpha (TNF-[a]), which worsen the inflammatory response..[9,10] Obesity, even without any underlying lung illness, leads to physiological compromise in lung function because of the increased burden on the respiratory system.[11]The Body Mass Index (BMI), Waist Circumference (WC), and Waist-to-Hip Circumference Ratio (WHR) are often used in clinical practice as straightforward indicators of obesity. According to the World Health Organization's definition of Body Mass Index (BMI), obesity is defined as having a BMI over 30 kg/m². However, for the Indian population, obesity is defined as having a BMI above 23 kg/m². Individuals with a waist circumference over 90 cms for males and 80 cms for women are at a heightened risk of experiencing metabolic problems.[12] the correlation between risk factors for cardiovascular disease and other chronic illnesses. Specifically, a waist-hip ratio (WHR) over 1 in males and 0.85 in women suggests the buildup of abdominal fat. According to the World Health Organization's definition of Body Mass Index (BMI), obesity is defined as having a BMI over 30 kg/m². However, for the Indian population, obesity is defined as having a BMI above 23 kg/m². Obesity may cause a decrease in pulmonary compliance, lung volumes, and the diameter of peripheral airways. It can also impact the amount of blood in the lungs and the link between ventilation and perfusion. Pulmonary compliance is diminished as a result of fat

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compression and infiltration of the thorax, or the augmentation of lung blood volumes. Obesity may also cause airway restrictions, resulting in decreased FEV1 and FVC11. Obese people have alterations in lung physiology that result in shallow breathing and decreased lung capacities, particularly in the expiratory reserve capacity. The decrease in lung volumes is linked to a decrease in the diameter of peripheral airways, which might result in alterations in the function of bronchial smooth muscle. Consequently, this results in a modification of the actinmyosin cross-bridge cycle, which has the potential to enhance both obstruction and bronchial hyper-reactivity (BHR).[14]Obesity-related conditions such as dyslipidemia, gastroesophageal reflux disease (GERD), hypertension, obstructive sleep apnea, and type 2 diabetes mellitus exacerbate asthma.[15]Numerous global investigations have been conducted on the correlation between asthma and obesity. These studies indicate that obese individuals with asthma have worse lung function and have higher rates of illness and death compared to non-obese individuals with asthma. In India, there is a scarcity of research conducted on asthmatics who are obese and those who are not obese. Therefore, this research was conducted to assess the disparities in pulmonary function test, BMI (body mass index), and clinical profile between asthmatics who are fat and those who are not obese.

MATERIALS AND METHODS

A cross-sectional observational research was conducted at the Pulmonary Medicine department. All patients with bronchial asthma who met the specified inclusion and exclusion criteria were included in the study after receiving written informed consent. The information required includes demographic data, historical background, clinical examination findings, and specific details on investigations such as Pulmonary function test, Complete hemogram (including Haemoglobin, Total leukocyte count, and Differential leukocyte count), Chest X-ray (Postero-anterior view), and Electrocardiogram. The lipid profile includes measurements of triglycerides, total cholesterol, high density lipoprotein (HDL), and low density lipoprotein (LDL). Additionally, the sputum AFB test and renal function test are performed.

Methodology

A cohort of 100 participants, consisting of 50 obese and 50 non-obese people with asthma. According to the World Health Organisation (WHO) Asia Pacific viewpoint for Asians, those with a BMI less than 22.9 are considered non-obese, while those with a BMI more than 23 are considered obese. Adults aged 18 and above. All individuals who have received a diagnosis of bronchial asthma in accordance with the parameters set by the GINA and are of adult age. This research included all adult individuals with asthma who were classified as obese, including those at risk, according to the World Health Organisation. Additionally, individuals who were classified as non-obese, including those who were underweight and those with a normal weight, were also included in the study. Unstable individuals receiving inpatient or outpatient care, (For example, a sudden worsening of asthma symptoms) Individuals suffering with chronic obstructive pulmonary disease, bronchiectasis, and other respiratory ailments. Individuals affected with cancers, heart issues, or neuromuscular illnesses were excluded from the study. The research excluded post-operative patients as well as persons with major systemic disorders such as chronic renal failure or complex diabetes mellitus.

Statistical Data

SPSS version 25.0 was used for statistical analysis. The groups were compared using the chi-square test, independent t-test, and ANOVA. A P value below 0.05 is deemed statistically significant.

RESULTS

The research included 100 individuals with bronchial asthma who were diagnosed according to the GINA standards. Among the sample of 100 patients, half were diagnosed with bronchial asthma and were obese, whereas the other half were diagnosed with bronchial asthma but were not obese. This research included 100 patients, with their ages ranging from 21 to 58 years. Among the obese group, the ages varied from 27 to 62 years, with a mean age of 39.85 ± 5.25 years. In the non-obese group, the ages ranged from 21 to 49 years, with a mean age of 33.39 ± 3.74 years. Among the 100 asthmatic patients analysed, 38% of the obese asthmatic group consisted of male patients (19 individuals), while 62% were female patients (31 individuals). In the non-obese asthmatic group, 72% were men (36 individuals) and 28% were females (14 individuals). The correlation between the groups is statistically significant. The p-value is 0.007. [Table 1]

The average BMI of the patients in the obese group was 31.25±3.28 kilogrammes per square metre, whereas in the non-obesity group it was 21.24±1.25 kg/m2. Among the 100 patients examined, 16 (32%) of the obese asthmatics and 3 (6%) of the non-obese asthmatics had a prior history of hypertension. A strong correlation was seen between the groups (p=0.03). Among the 100 individuals examined, 12 (24%) of the obese asthmatics and 3 (6%) of the non-obese asthmatics had a prior history of diabetes mellitus. The average percentage change in reversibility of spirometric readings is 34.07% in the non-obese group and 29.24% in the obese population. The student t test determined that the p value for this variable between the groups is not statistically significant. The probability is 0.15. The bronchodilator response was seen to be greater in

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the non-obese asthmatic group as compared to the obese asthmatic group, however this difference did not reach statistical significance. [Table 2]

The average Forced Expiratory Volume in 1st second (FEV1) and Forced Vital Capacity (FVC) in obese asthmatics are 1.21±0.14 l/s and 1.71±0.44 l/s, respectively. In non-obese individuals, the average FEV1 is 1.61+0.41 l/s and the average FVC is 2.91+0.28 l/s. In this research, the average value of FEF 25-75% in obese asthmatics is 1.29+0.29 l/s, whereas in non-obese individuals it is 1.64+0.19 l/s. In our research, we also examined the average value of FEV1/FVC % for both the obese and non-obesity groups. The mean value for the obese group was 69.96 +6.63, whereas the mean value for the non-obese group was 66.18 ±4.25. [Table 4]

Table 1: Basic profile of the participants

	Obese bronchial asthma patients		Non obese bronchial asthma patients		P value
	Number	Percentage	Number	Percentage	
Gender					0.007
Male	19	38	36	72	
Female	31	62	14	28	
Age					
Below 30	6	12	16	32	
30-40	22	44	20	40	
40-50	12	22	7	14	
50-60	7	14	5	10	
Above 60	3	6	2	4	
Mean	39.85±5.25		33.39±3.74		
BMI	31.25 ±3.28		21.24 ±1.25		
Co-morbidity					
Hypertension	16	32	3	6	0.03
Diabetes mellitus	12	24	3	6	0.15

Table 2: WHO Classification of BMI

Classification	BMI(Kg/m2)	Risk of Co-morbidities
Underweight	Less than18.5	Low-but risk of other clinical problem increased
Normal Range	18.5-24.9	Average
Overweight	>25±	
Pre Obese	25-29.9	Increased
Obese Class I	30-34.9	Moderate
Obese Class II	35-39.9	Severe
Obese Class III	>40	Very Severe

Table 3: Comparing PREFVC, FEV1, FEV1/FVC, FEF (25-75) in Obese and Non-Obese Asthmatics

	Obese			Non Obese		
PFT Values	Predicted	Observed	% of Observed FVC	Predicted	Observed	%
FVC	2.52±0.35	1.71±0.44	67.52±5.25%	2.91±0.28	2.32±0.74	80.20±5.25%
FEV1	2.21±0.35.	1.21±0.14	56.15±4.28%	2.51±0.45	1.61±0.41	60.74±5.47%
FEV1/FVC	87.55 ±3.22	69.96 ±6.63	87.01 ±3.63%	87.11±3.59	66.18 ±4.25	86.89+3.74%
FEF(25-75)	3.33±0.77	1.29±0.29	43.31±4.15%	3.91±0.61	1.64±0.19	39.85±4.47%

Table4: Comparing POST FVC, FEV1, FEV1/FVC,FEF (25-75)in Obese and Non-Obese A asthmatics

	Obese		NonObese	
PFT Values	Observed	%of observed	Observed	%of observed
FVC	1.89±0.24	80.25±4.52 %	2.62±0.74	92.28±6.39 %
FEV1	1.52±0.18	71.29±4.39 %	1.96±0.69	79.63±5.28 %
FEV1/FVC	76.89 ±2.85	-	75.28 ±5.36	-
FEF(25-75)	1.96±0.41	62.28±3.25 %	2.83±0.85	72.25±4.39 %

DISCUSSION

This research included 100 patients, with their ages ranging from 21 to 58 years. Among the obese group, the ages varied from 27 to 62 years, with an average age of 39.85±5.25 years. In the non-obesity group, the ages ranged from 21 to 49 years, with an average age of 33.39±3.74 years. Among the 100 asthmatic patients examined, 38% of the obese asthmatic group were male (19 patients) and 62% were female (31 patients). In the non-obesity asthmatic group, 72% were male (36 patients) and 28% were female (14 patients). The correlation between the groups is statistically significant. The p-value is 0.007.

Castro-Rodriguez et al. provided evidence that girls who experience weight gain and become overweight or obese between the ages of 6 and 11 are more likely to acquire new symptoms of asthma. The average BMI of the patients in the obese group was 31.25 ±3.28 kilograms/metre2, whereas in the non-obese group it was 21.24 ±1.25 kg/m2.[16]The research results are similar to the study conducted by Misra A et al.[17]

Beuther et al have shown a definitive correlation between BMI and asthma, indicating that the risk of asthma escalates with higher body weight.

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Furthermore, he demonstrated that the likelihood of developing asthma in overweight and obese individuals of both genders was comparable.[18] The predominant symptom seen in both groups was dyspnea, which was present in all patients in the obese group and 90% of the non-obese group. This was followed by cough and wheezing. The current investigation demonstrated a notable correlation between cough and seasonal fluctuations among asthmatic patients, comparing the results to a study conducted by Peters U et al.[19]This link was seen in both obese and non-obese individuals. The prevalence of co-morbidities such as diabetes and hypertension was higher in obese individuals compared to non-obesity individuals, which aligns with the findings of Beuther'sresearch.[18]Our analysis demonstrates a substantial disparity in the Absolute eosinophil count across the groups.The results of the research conducted by Fenger RV et al,[5] contradicted the findings, with a significance level of p=0.05.

The average Forced Expiratory Volume in 1st second (FEV1) and Forced Vital Capacity (FVC) in obese asthmatics are 1.21±0.14 l/s and 1.71±0.44 l/s, respectively. In non-obese individuals, the average FEV1 is 1.61+0.41 l/s and the average FVC is 2.91+0.28 l/s. The current investigation found that obese asthmatics had decreased FEV1 and FVC compared to non-obese asthmatics, which is consistent with the findings of Chen Z et al.[20]The average percentage change in spirometric readings (FEV1) indicating reversibility is 36% in the non-obese group, whereas it is 30% in the obese population. However, the results did not reach statistical significance. The value of p is 0.17. In contrast to the research conducted by Fenger RV et al, our analysis revealed a substantial disparity in the spirometric characteristics between asthmatics who were fat and those who were not obese. In our research, we also examined the average value of FEV1/FVC % for both the obese and non-obesity groups. The mean value for the obese group was 69.96 +6.63, whereas the mean value for the non-obese group was 66.18 ±4.25. This conclusion aligns with the research conducted by Sharma et al, whereas it contradicts the findings of the study conducted by Castro-Rodriguez et al.

In this research, the average value of FEF 25-75% in obese asthmatics is 1.29+0.29 l/s, whereas in non-obese individuals it is 1.64+0.19 l/s. The data exhibited a reduced magnitude in comparison to non-obese individuals with asthma, a finding that aligns with the research conducted by Misra A et al.[17]Prior research shown a large mean percentage change in the reversibility of spirometric values in the non-obese population. However, our study presents contrasting findings.[14]

CONCLUSION

There is a growing occurrence of asthma and obesity, indicating a connection between the two. The predominant symptoms identified in this research were dyspnea, cough, and wheezing. The pulse rate, SBP, DBP, RR, TLC, AEC and LP were elevated in individuals with obesity and asthma. Obese asthmatics had a higher prevalence of diabetes mellitus and hypertension. In obese individuals with asthma, the FVC and Forced Expiratory Volume in 1 second (FEV1) are reduced. However, non-obese individuals with asthma have a greater degree of reversibility. An further observation was made that higher BMI leads to diminished pulmonary function.

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