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Impact of obesity on spirometric parameters in asthmatic

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Abstract

Obesity is a public health issue and a risk factor and disease modifier for juvenile and adult asthma. Due to the high prevalence of obesity and asthma, this connection may worsen asthma burden in individuals and populations. The extent to which obesity impressing lung function still vague. This research focus on impact of obesity on asthmatic spirometric parameters. Aim of the study: To determine the effect of obesity on spirometry parameters in asthmatic patients. 93 asthmatic patients are enrolled in this cross-sectional study. The diagnosis of asthma was made clinically and by PFT. The study done in Baghdad teaching hospital from 6 June 2023 to 16 January 2024. 45 (48.3%) of the 93 patients are classified as obese (BMI>=30) according to CDD.69.9% are female and 30.1% are male. Patients with a BMI ≥30 had a considerably older mean age (43.86 years vs. 38.27 years) and a higher mean PEFR% (52.37% vs. 43.39%) than those with a BMI less than 30. BMI is significantly correlated with FEF25-75, age, sex, and PEFR%. There is no statistically significant correlation observed between BMI and other parameters. Additionally, it was observed that females exhibited a higher FEF25-75% (a significant correlation between gender and FEF25-75%). This study shows that asthmatics, especially women, are obese. Different spirometric characteristics connected with BMI. FEF25-75 and PEFR % correlated, whereas others did not. In obese asthmatics, dysanapsis is a leading explanation for this observation. Obesity worsens asthma severity, exacerbations, and medication responsiveness, despite this favorable connection of several PFT variables to BMI.

Keywords: Prevalence, obesity, asthmatic, effects, spirometric, parameters

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Introduction

Asthma is a chronic syndrome marked by variable airflow obstruction and a distinct inflammation type in the airways, making individuals highly responsive to various triggers. This condition leads to airway narrowing, reduced airflow, and symptoms like wheezing and dyspnea, which are often reversible, though some chronic cases may show irreversible obstruction. Asthma affects approximately 300 million people worldwide and has seen a rise in prevalence, especially in affluent countries over the last 30 years; however, the numbers have recently stabilized, affecting 10-12% of adults and 15% of children globally [1]. The disease is influenced by both genetic and environmental factors, with identified risk factors that differ from triggers, which exacerbate symptoms in those with established asthma [1]. Diagnosing asthma involves recognizing symptoms like shortness of breath, wheezing, and cough, particularly noting that they intensify at night or early morning and vary in intensity and time [2]. Symptoms triggered by exercise, allergen exposure, and environmental irritants like smoke also point towards asthma. Diagnosis is confirmed through variability in expiratory airflow limitation and pulmonary function tests, which include measuring changes in FEV1 and PEF to confirm asthma [3-5]. Obesity, defined by excessive fat accumulation causing health issues, is a significant asthma risk factor. It is typically measured using body mass index (BMI), with a BMI ≥ 30 kg/m2 indicating obesity. Obesity not only increases the risk of developing asthma but also leads to more severe symptoms and reduced responsiveness to treatments. Reports suggest a four to six times higher risk of hospitalization for obese asthmatic patients compared to non-obese ones. The relationship between obesity and asthma is consistent across different ages and populations, suggesting a causal relationship where obesity precedes asthma onset and weight reduction might improve asthma symptoms [6-10]. Aim of the study: To determine the effect of obesity on spirometry parameters in asthmatic patients.

Method

This cross-sectional study, conducted between June 6, 2023, and January 16, 2024, at Baghdad teaching hospital, aimed to explore the impact of Body Mass Index (BMI) on spirometric parameters among asthma patients. The study included 93 patients with a confirmed clinical and spirometric diagnosis of asthma. Participants were recruited based on the following inclusion criteria: both males and females, aged 18 years or older, with a clinically and spirometrically confirmed asthma diagnosis. The exclusion criteria were designed to omit any potential confounding factors that could affect the respiratory system, excluding individuals who were pregnant, had postviral reactive airway disease, were smokers, had Chronic Obstructive Pulmonary Disease (COPD), or interstitial lung disease. Demographic data including age, gender, weight, and height were collected on the same day as the spirometry tests to ensure consistency. Smoking status was also recorded to maintain the integrity of the exclusion criteria. Spirometry was conducted by trained pulmonary function technologists in the pulmonary clinics of Baghdad teaching hospital. The spirometric assessments recorded included Forced Expiratory Volume in the first second (FEV1), Forced Vital Capacity (FVC), FEV1/FVC ratio, Forced Expiratory Flow at 25-75% of the pulmonary volume (FEF25-75%), and Peak Expiratory Flow (PEF). BMI was calculated for each patient using the formula of weight in kilograms divided by height in meters squared. The classification of BMI was determined according to the guidelines provided by the Centers for Disease Control and Prevention (CDC) [11], allowing the categorization of patients into different BMI classes for analysis. This approach aimed to delineate the relationship between varying degrees of obesity and the respiratory parameters measured by spirometry, thereby elucidating any potential impact of BMI on lung function in asthmatic individuals. Statistical analysis Data were handled with Excel 2010 and SPSS 26. Data were presented as means with standard deviations and frequencies for quantitative and qualitative factors. Data normality was tested with

Shapiro-Wilk. Qualitative and quantitative factors were compared using Chi-squared and Mann-Whitney U tests. Univariate and multivariate logistic regression models were used to analyse variables at BMI < 30 kg/m2 and BMI ≥ 30 kg/m2. Pearson's correlation test examined age and sex's effects on lung function.

Results

93 patients with asthma were recruited into the sample. Age of enrolled patients ranged between 18 and 65 years with an average of 40.97 years. Mean BMI in the sample was 30.37 kg/m^2 with a range from 19.03kg/m^2 to 46.80 kg/m^2. 28 (30.1%) of patients were male while 65 (69.9%) were female. Means of FEV1% predicted, FVC% predicted, FEV1/FVC ratio, PEFR% predicted, and FEF25-75%predicted were 58.05, 76.21, 64.31, 47.74, and 41.39 respectively. Demographic characteristics and lung functions are shown in table (1). Ratio of male to female was expressed using pie chart as shown in figure.1. Distribution of BMI (kg/m^2) among the enrolled patients was illustrated using histogram chart (figure.2). Compared to Patients with BMI < 30 kg/m^2 those with BMI ≥ 30 kg/m^2 had a significantly older mean age (43.86 years' vs 38.27 years, *p-value* 0.009) and higher mean PEFR% (52.37 vs 43.39, *p-value* 0.04). Other variables were not markedly different between BMI < 30 kg/m^2 and BMI ≥ 30 kg/m^2 groups (table.2). Using logistic regression models univariable analysis (table.3) showed that BMI was significantly correlated with Age(odd ratio1.051, 95% confidence interval 1.009-1.094, *p-value* 0.016), Sex(odd ratio 0.237, 95% confidence interval 0.088- 0.636, *p-value* 0.004), PEFR% predicted(odd ratio1.023, 95% confidence interval 1.001 -1.046, *p-value* 0.03), and FEF25-75% predicted(odd ratio1.022, 95% confidence interval1.000-1.044, *p-value* 0.04). Other parameters were not significantly correlated with BMI. Association of BMI with FEF25-75% and PEFR% predicted are represented using scatterplot in figure.3 and figure.4 respectively. In multivariable analysis (table 4) only Age (odd ratio1.048, 95% confidence interval 1.001-1.097, *p-value* 0.044) and Sex (odd ratio 3.268, 95% confidence interval1.113-9.595, *p-value* 0.031) were found to be significantly associated with BMI. Using Pearson's correlation test (table.5) sex was shown to be significantly correlated with FEF25-75% predicted (r -0.218, *p-value* 0.03). We did not a find significant association between other parameters.

Table 1.

(Demographics and lung functions of the enrolled patients)

Variable	**Patients(n=93)**
Age(years) Mean (SD)	40.97(10.97)
Sex;n(%) Male/female	28(30.1%)/65(69.9%)
BMI(kg/m^2) Mean(SD)	30.37(5.77)
FEV1(%) Mean(SD)	58.05(21.36)
FVC(%) Mean(SD)	76.21(19.11)
FEV1/FVC (ratio) Mean(SD)	64.31(19.43)
PEFR(%)Mean(SD)	47.74(20.42)
FEF25-75% pred Mean (SD)	41.39(20.44)

**BMI; body mass index, FEV1; Forced expiratory volume in the first second,FVC; Forced vital capacity,PEFR Peak expiratory flow rate, FEF; forced mid-expiratory flow, SD; standard deviation.*

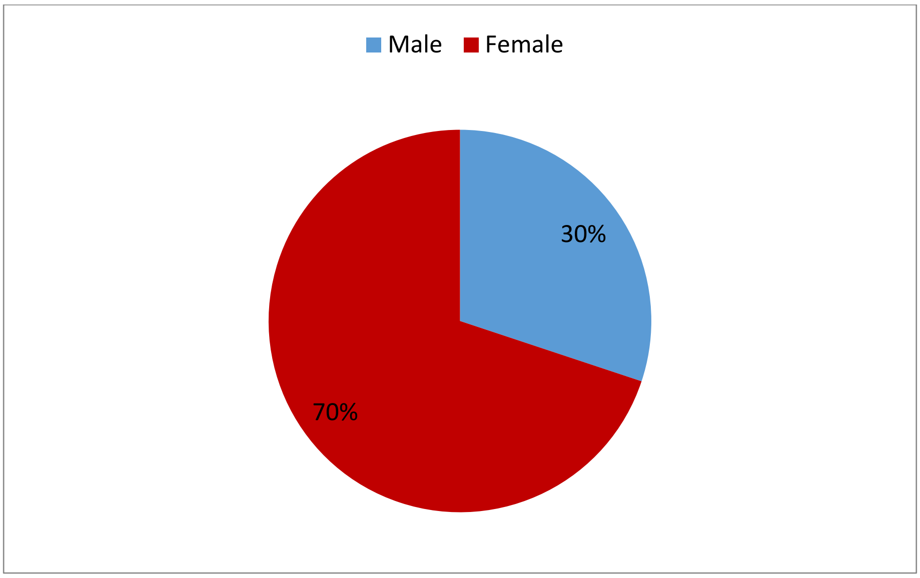

Figure 1.

(Male to female ratio).

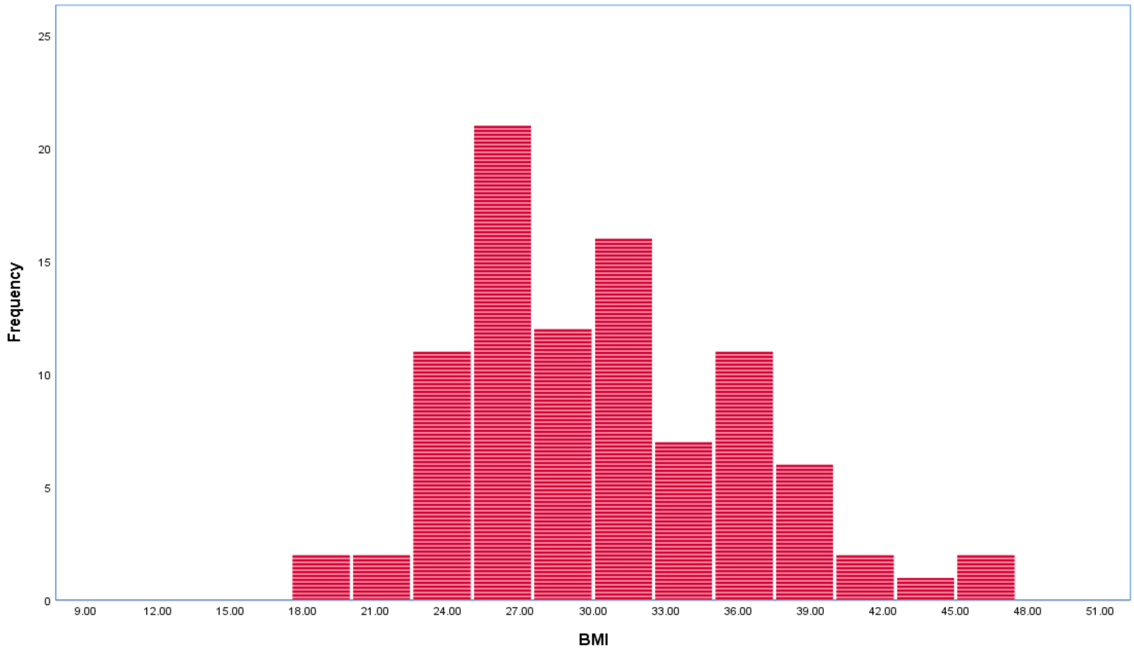

Figure 2.

(Histogram showing distribution of BMI in kg/m^2)

Table 2.

(Comparison of demographics and lung functions between BMI < 30 kg/m² and BMI ≥ 30 kg/m² groups).

Variable	BMI < 30 kg/m² (n=48)	BMI ≥ 30 kg/m² (n=45)	*p-value*
Age(years) Mean(SD)	38.27(11.60)	43.86(9.57)	0.009
Sex;n(%) Male/female	21(43.75%)/27(56.25 %)	7(15.55%)/38(84.45%)	0.003
BMI(kg/m²) Mean(SD)	25.82(2.41)	35.21(4.11)	< .00001
FEV1(%) Mean(SD)	53.89(20.36)	62.48(21.72)	0.053
FVC(%) Mean(SD)	75.20(17.38)	77.28(20.94)	0.84
FEV1/FVC(ratio) Mean(SD)	61.48(19.85)	67.34(18.72)	0.09
PEFR(%) Mean(SD)	43.39(18.20)	52.37(21.80)	0.04
FEF25-75%pred Mean(SD)	37.22(18.57)	45.84(21.59)	0.05

**BMI; body mass index,FEV1; Forced expiratory volume in the first second ,FVC; Forced vital capacity, PEFR Peak expiratory flow rate, FEF; forced mid-expiratory flow, SD; standard deviation, p-value was considered significant at less than 0.05*.

Table 3.

(Univariable analysis of factors associated with BMI)

Variable	Odd ratio	95% C.I.	*p-value*
Age	1.051	1.009-1.094	0.016
Sex	0.237	0.088- 0.636	0.004
FEV1%	1.020	1.000-1.041	0.05
FVC%	1.006	0.984-1.028	0.59
FEV1/FVC ratio	1.016	0.994-1.039	0.14
PEFR%	1.023	1.001 -1.046	0.03
FEF25-75%	1.022	1.000-1.044	0.04

**BMI; body mass index,FEV1; Forced expiratory volume in the first second, FVC; Forced vital capacity,PEFR Peak expiratory flow rate, FEF; forced mid-expiratory flow, C.I.; confidence interval, p-value was considered significant at less than 0.05.*

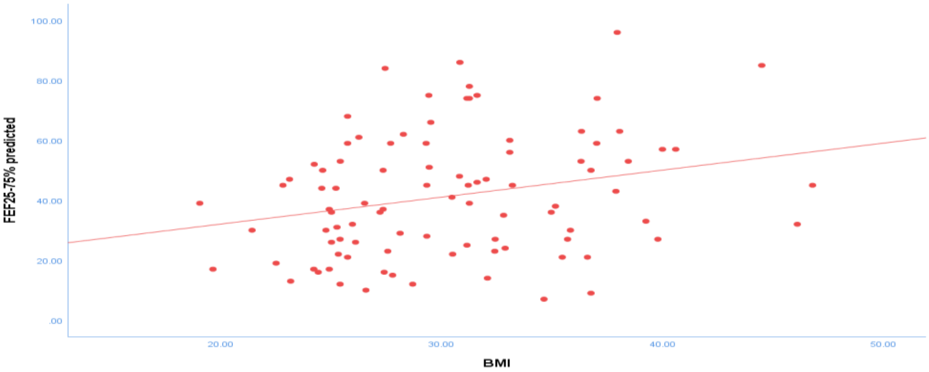

Figure 3.

(Correlation of BMI in kg/m^2 with FEF25-75%predicted)

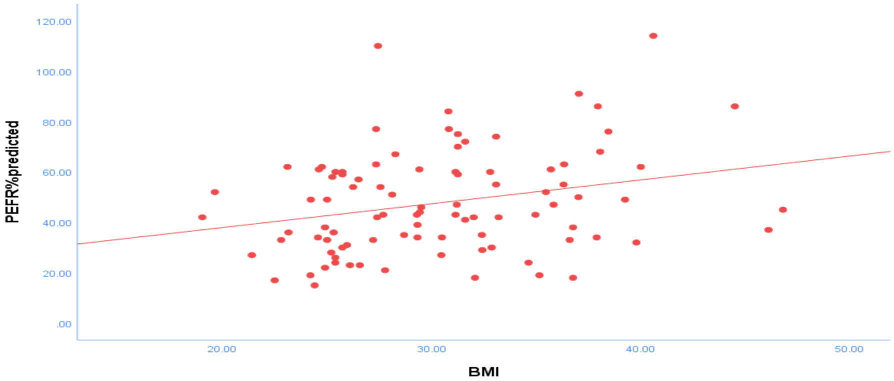

Figure 4.

(Correlation of BMI in kg/m^2 with PEFR% predicted)

Table 4.

(Multivariable analysis of risk factors associated with BMI)

Variable	Odd ratio	95% C.I.	*p-value*
Age	1.048	1.001-1.097	0.044
Sex	3.268	1.113-9.595	0.031
FEV1%	1.041	0.967-1.122	0.287
FVC%	0.964	0.905-1.027	0.256
FEV1/FVC ratio	0.965	0.905-1.029	0.280
PEFR%	1.024	0.985-1.064	0.228
FEF25-75	1.006	0.969-1.045	0.753

**BMI; body mass index, FEV1; Forced expiratory volume in the first second, FVC; Forced vital capacity,PEFR Peak expiratory flow rate, FEF; forced mid-expiratory flow, C.I.; confidence interval, p-value was considered significant at less than 0.05.*

Table 5.

(Correlation of Age and sex with lung functions)

	FEV1% (R, *p-value)*	FVC% (R, *p-value)*	FEV1/FVC (R, *p-value)*	PEFR% (R, *p-value)*	FEF25-75 (R, *p-value)*
Age	0.060,0.56	-0.097, 0.35	0.142,0.17	-0.063, 0.54	0.022,0.83
Sex	-0.101, 0.33	0.016,0.87	-0.139, 0.18	-0.106, 0.31	-0.218, 0.03

** FEV1; Forced expiratory volume in the first second, FVC; Forced vital capacity,PEFR Peak expiratory flow rate, FEF; forced mid-expiratory flow, p-value was considered significant at less than 0.05.*

Discussion

This cross-sectional study assessed the impact of obesity on spirometric parameters in adult asthmatic patients, revealing significant findings and correlations amidst varying global studies. The study recorded a higher prevalence of female participants (69.9%), aligning with findings that asthma shifts from being more prevalent in young males to females in adulthood, likely influenced by sex hormone changes associated with puberty, the menstrual cycle, and pregnancy [12]. In this cohort, obesity prevalence was 48.3%, with women predominantly affected (84.4%), consistent with research suggesting a stronger linkage between asthma and obesity in women compared to men [13,14]. Longitudinal studies have identified obesity as a significant risk factor for asthma in women [15]. The present study found a significant positive correlation between BMI and two spirometric measures: Peak Expiratory Flow Rate (PEFR) and Forced Expiratory Flow at 25-75% (FEF 25-75). This contrasts with other parameters like Forced Expiratory Volume in the first second (FEV1) and Forced Vital Capacity (FVC), which did not show a significant correlation with BMI. Comparative insights from global studies illustrate the complex relationship between obesity and asthma. A study from Babylon in 2021 showed higher FEV1% and PEF and FEV1/FVC in obese asthmatics (16), while a study from Brazil echoed similar findings for FEV1% [17]. However, contrasting results from Kashan and AL Kadhmiya reported varying impacts of obesity on FEV1/FVC and FEF25-75%, with no significant correlation observed in some instances [18,19]. Meanwhile, recent findings from Saudi Arabia in 2023 indicated a significant decline in all measured spirometric parameters among obese asthmatics [20]. These discrepancies across studies suggest that the impact of obesity on spirometric outcomes in asthmatics may not be definitive and could be influenced by factors such as patient effort, test conditions, and spirometer calibration. Furthermore, the variability in results underscores the importance of not relying solely on spirometric values for asthma management. For instance, a study by Stempel et al. highlighted that many patients with uncontrolled asthma ACT scores still exhibited normal spirometric values, suggesting that combination of both testes may be necessary more precise control determination [21]. In non-asthmatic obese individuals, several studies have noted decreased FEV1 and FVC, though the FEV1/FVC ratio generally remains stable or slightly increases, highlighting potential physiological differences in lung function between asthmatic and non-asthmatic populations [22-24]. This phenomenon, known as dysanapsis, refers to a mismatch in growth between lung size and airway caliber, which might be influenced by both obesity and asthma [25]. Clinically, obesity augment asthma severity, reduces responsiveness to treatments like inhaled corticosteroids, and affects overall asthma control and symptoms [26,27]. Importantly, weight reduction strategies, including bariatric surgery, have been shown to improve quality of life and asthma control, illustrating the potential benefits of addressing obesity in asthma management [28,29]. These findings collectively highlight the multifaceted impacts of obesity on asthma, necessitating a holistic approach to treatment that considers both pulmonary function and body weight management.

Conclusion

This study shows that asthmatics, especially women, are obese. Different spirometric characteristics connected with BMI. FEF25-75 and PEFR % correlated, whereas others did not. In obese asthmatics, dysanapsis is a leading explanation for this observation. Obesity worsens asthma severity, exacerbations, and medication responsiveness, despite this favorable connection of several PFT variables to BMI.

Conflict of Interest

No conflicts of interest were declared by the authors.

Financial Disclosure

The authors declared that this study has received no financial support.

Ethics Statement

Approved by local committee.

Authors' contributions

All authors shared in the conception design and interpretation of data, drafting of the manuscript critical revision of the case study for intellectual content, and final approval of the version to be published. All authors read and approved the final manuscript.

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