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Original Research Article

Comparison of exercise induced bronchospasm using peak expiratory flow rate in obese and non-obese young females

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ABSTRACT

Background: Obesity significantly alters respiratory mechanics, increasing susceptibility to Exercise-Induced Bronchospasm (EIB) a reversible airway constriction during or after physical activity which often limits exercise participation. This study aimed to compare EIB prevalence and severity using Peak Expiratory Flow Rate (PEFR) between obese and non-obese young females.
Methods: This comparative experimental study involved 60 female participants (age >19 years), divided into two cohorts based on Body Mass Index (BMI): Group A (Obese, n=30) and Group B (Non-obese, n=30). Pulmonary function was measured via PEFR at baseline and immediately following a standardized 400-meter run to identify airway obstruction consistent with EIB.
Results: Post-exercise, the obese group exhibited a substantial decline in lung function, with mean PEFR dropping from 373.1 L/min to 342 L/min (an 8.3% decrease). Conversely, the non-obese group showed minimal change, moving from 388.8 L/min to 375.2 L/min (a 3.5% decrease). Notably, 40% of obese participants met the diagnostic criteria for EIB, compared to only 10% of the non-obese cohort.
Conclusions: EIB is significantly more prevalent and severe in obese young females. These findings suggest that respiratory symptoms often attributed to general deconditioning in obese individuals may actually stem from underlying EIB. Addressing this airway hyper-responsiveness is crucial for improving physical activity tolerance in this population.

Keywords: BMI, Exercise-induced bronchospasm, Obesity, Peak expiratory flow rate, Pulmonary function

INTRODUCTION

Obesity is a chronic medical condition, it is caused due to excess accumulation of fat in the human body, which further causes serious health conditions.[1] The pathophysiology of obesity involves genetic predisposition, environmental variables, behavioural factors, metabolic alterations, hormonal dysregulation, and psychological determinants and various other factors.[2] Anthropometric measures are generally used in analysis and assessment.[3]

The World Health Organization (WHO) states that the Body Mass Index (BMI) is the most widely used and popular method for determining obesity.[4] It is calculated using the formula BMI =Weight (kg)/Height $(m)^2$, and it is further categorized by the Asian BMI classification (WHO recommended) as Class 1: BMI of 30 to less than 35, Class 2: BMI of 35 to less than 40, Class 3: BMI of 40+.[5,6]

Obesity has a substantial impact on the respiratory system both physically and functionally, as well as the inflammatory and mechanical systems.[7] It may also result in respiratory issues and impact the mechanics of lung volumes, ventilation, and gaseous exchange.[8] Exercise increases the requirement for ventilation, which exacerbates airway tightness and makes breathing more difficult.[9] This raises stress levels and increases the risk of respiratory symptoms like exhaustion, tightness in the chest, and dyspnoea in obese people.[10]

A transient and reversible constriction of the bronchial smooth muscles that restricts airflow during or after physical activity is known as exercise-induced bronchospasm (EIB).[11] Shortness of breath, a dry cough, and wheezing during or immediately following intense exercise are some of the signs of this illness.[12] Different populations may have different EIB diagnosis criteria; a 20% to 25% decrease occurs after activity.[13] A smaller 10% decrease from baseline is used to identify EIB in athletes and obese women, while PEF is the benchmark for diagnosing EIB in asthmatics.[14] Traditionally linked to asthma, obese individuals without a history of asthma are now more likely to be diagnosed with EIB.[15] Obesity is a frequent problem that is spreading throughout this community.[16] When exercising, the condition may exacerbate respiratory problems and make leisure activities more difficult.[17] Activity-induced bronchospasm, which typically occurs after or within 20 minutes of completing moderate to intense activity, is believed to affect up to 90% of obese patients.[18]

Due to differences in airway size, EIB is more common in women than in men.[19] It has a unique clinical epidemiology and can happen at any age.[20] Patients who are obese frequently have more severe bronchial constriction and a slower return to baseline lung function after exercise.[21] Sedentary lifestyles and infrequent physical activity are more strongly linked to an increased risk of asthma-like symptoms and can worsen the severity of EIB.[22] Physical problems can significantly impact well-being by possibly impairing cardiovascular health and promoting a sedentary lifestyle, which can lead to obesity and lower quality of life in general.[1,8] Peak Expiratory Flow (PEF), which is the greatest airflow produced during a forced exhale starting from total lung capacity, is used to compare lung function before and after exercise in order to evaluate EIB.[3]

Peak expiratory flow rate, or PEFR, is a useful measure of both airflow restriction and adequate ventilation.[3,18] It is calculated as the volume of air forcefully expelled from the lungs in a single rapid exhalation.[2] The typical peak flow value varies from person to person and is influenced by things like height, age, and sex.[19,20] Males often have higher PEFR than females, and taller individuals typically have higher PEFR.[22] As expected, there is a rise in childhood and adolescence and a fall in age starting in the 30s and 40s.[3,18] Peak expiratory flow (PEF), a crucial lung function metric, provides physicians with crucial information on asthma treatment.[12,18] PEF is an objective indicator of airway restriction that helps in asthma treatment evaluation and exacerbation management.[3] A peak flow meter is often used to evaluate it.[1,3] Accurate data from a peak flow meter requires a lot of effort.[3] PEF is influenced by airway diameter, voluntary effort, muscle strength, and the depth of the previous breath.[12] To detect inadequate effort or skill, clinicians should use a peak flow meter to monitor patients.[3] Nevertheless, there is device heterogeneity and no reliable method for calibrating readings between various flow meters.[3] Clinicians and patients should select PEF meters that adhere to the guidelines set forth by the International Organization for Standardization.[3]

Peak flow meters come in a variety of forms.[3] The typical peak flow meter is a straightforward, portable, cylindrical instrument that patients can use repeatedly.[1,3] It has a mouthpiece, an indicator, and measurements all over the body.[3] Certain electronic meters have the ability to capture and send readings to the supplier.[18] There are also portable electronic spirometers that can be used at home to test FVC, FEV1, and PEF.[3,18]

METHODS

The study was conducted among the obese and non-obese young females to compare the Peak Expiratory Flow Rate (PEFR).

The study received approval from the Ethical Committee on 2025. The duration of the study was from January 2025 to January 2026. The study conducted was a comparative experimental study.

For the study, the sample size was 60. Participants were selected on the basis of inclusion and exclusion criteria and allocated into two groups: 30 obese females and 30 non-obese females. Specifically, females presenting with a history of asthma, chronic respiratory conditions, cardiovascular diseases, recent acute respiratory infections, a history of smoking, or physical limitations precluding them from performing the exercise test were excluded from the study. Participants were clearly explained about the study before the consent form was given. The written consent was taken regarding the study prior to the study. Also, confidentiality of information was explained and assured.

Each participant's baseline information was collected; pre-exercise PEFR was assessed prior to the exercise testing. Aim, objective, and procedure of the study were briefed prior to the test. Exercise testing was performed on a 400-meter ground. After the exercise was completed, post-exercise PEFR was noted after a rest period.

The data was collected and was statistically analyzed. The results were obtained and conveyed through tables.

Peak expiratory flow rate and exercise procedure

The peak expiratory flow rate (PEFR) was used for the assessment. The participant was in a standing position with the mouthpiece placed comfortably. Once the participant was ready, baseline PEFR was recorded. The participant then performed the exercise on a standard 400-meter ground. Following the cessation of exercise, a rest interval was observed. The post-exercise PEFR was assessed exactly after 10 minutes to evaluate airway responsiveness.

InStat software and the Paired and unpaired t-test used.

RESULTS

Baseline respiratory function differed between the two groups, with the non-obese participants displaying a higher initial capacity. Following the standardized 400-meter run, both groups exhibited a reduction in lung function; however, the magnitude of this decline was significantly more pronounced in the obese group. The mean PEFR for obese females decreased from 373.1 L/min at baseline to 342.0 l/min post-exercise. In contrast, the non-obese group showed a minimal decline, dropping from 388.8 L/min to 375.2 l/min. The physiological response to exercise resulted in a higher incidence of airway obstruction among the obese participants. The data revealed that 40% of the obese group met the diagnostic criteria for EIB, compared to only 10% of the non-obese group. These findings indicated that young obese females experienced a higher prevalence and severity of exercise-induced airway restriction compared to their non-obese peers.

Table 1 show that the mean of PEFR dropped from 373.1 to 342 for the group of 30 obese young females following exercise.

Table 1: Peak expiratory flow rate pre and post exercise in obese young females.

	Assessment	Mean±SD	Paired ‘t’ test value	P value	Significance
Obese female	Pre	373.1±24.5	3.415	0.0028	Very significant
	Post	342±43.5			

Table 2 demonstrate that, among this obese cohort, 12 participants tested positive for the condition, whereas 18 participants tested negative.

Table 3 shows that the mean of PEFR dropping from 388.8 to 375.2 for the group of 30 non-obese young females following exercise.

Table 4 demonstrate that, among this non obese cohort, 3 participants tested positive for the condition, whereas the remaining 27 participants tested negative.

Table 2: Exercise induced bronchospasm in obese young females.

	Assessment	Total
Obese females	Positive (EIB)	12
	Negative (EIB)	18

The study concludes that obese females are markedly more susceptible to Exercise-Induced Bronchospasm (EIB), exhibiting both a greater incidence of positive cases and a more pronounced decline in pulmonary function relative to non-obese females (Table 5).

Table 3: Peak expiratory flow rate pre and post exercise in non-obese young females.

	Assessment	Mean±SD	Paired ‘t’ test value	P value	Significance
Non-obese female	Pre	388.8±23.8	4.311	0.0001	Extremely significant
	Post	375.2±28.5			

Table 4: Assessment of non-obese females.

	Assessment	Mean
Non-obese female	Positive	3
	Negative	27

Table 5: Comparison of PEFR in obese and non-obese young females.

	Assessment	Mean±SD	Paired ‘t’ test value	P value	Significance
Obese female	EIB difference	29±34.7	4.571	0.0004	Extremely significant
Non-obese female		13.63±17.3	4.311	0.0002	Extremely significant

DISCUSSION

The main purpose of this research was to investigate the distinct effects of obesity on airway responsiveness and respiratory mechanics after exercises. With the rapidly increasing trend of obesity among the young generation, it has become imperative for researchers and medical practitioners to understand its systemic effects, which have not yet been entirely determined by its established cardiovascular risks. Primarily, the purpose of this research paper was to examine the hypothesis that Exercise-Induced Bronchospasm (EIB), or the temporary constriction of air passages in response to or following exercise, was physically and chemically induced by excessive fats in the body. This research paper contributes significantly to establishing the distinct effect of obesity not only as a separate risk factor for exercise-induced respiratory obstruction but also as merely a comorbidity by employing Peak Expiratory Flow Rate in 60 young women.

Mechanical restrictions and baseline respiratory disparities

Evaluating the participants starting physiological status offers some insight into the respiratory response to exercise. From the findings of this study, it can be seen that there was a statistically significant difference between the two groups resting lung function. From the results, the mean resting PEFR for the obese participants (Group A) was considerably lower at 373.1 L/min compared to the non-obese participants (Group B) at 388.8 L/min. The respiratory system in young female obesity suffers from being at a mechanical disadvantage even at rest, indicated by this starting level of about 15.7 L/min lower. This finding correlated very well with all the knowledge available on pulmonary mechanics. Godara and Badyal (2019) in their study also reported similar findings in Indian women with BMI values of 30 kg/m² and above; Godara & Badyal, 2019; the PEFR values were significantly lower.[20] From their findings, the reduced PEFR values were attributed to the mass loading effects of adipose tissue on the chest wall and abdomen.[8] Due to the reduced compliances associated with the accumulation of fat in the chest wall, the muscular effort required for rib expansion increases.[8] Secondly, regarding their comparative study, Chinnaiyan & Ramayyan (2021) further verify this finding when they highlight the restrictions created by obesity regarding lung function.[22] They mainly describe how Obesity imposes its restrictive pattern upon lung function. The restrictive pattern is caused by how the diaphragm's movement is obstructed with increased abdominal hydrostatic pressure during inspiration.[8] This would definitely result in decreased Expiratory Reserve Volume (ERV) and Functional Residual Capacity (FRC) for the obese participants before starting the 400-meter run, thus setting them up for failure before the actual exercise challenge has been imposed upon them.[8]

The unique physiological response to the exercise challenge is the most significant finding derived from this study. A slight reduction in airflow is considered a typical physiological response due to exhaustion, yet the extent of reduction distinguishes it as normal response from pathologic bronchospasm. However, there was a slight physiological reduction of 13.63 L/min (from 388.8 L/min to 375.2 L/min) within the non-obese group (B) (t=4.311, p=0.0001). That is to say, the normal, non-obese airway possesses sufficient homeostatic mechanisms to maintain its patency even under conditions of heightened breathing stress. In sharp contrast, the obese group, Group A, displayed a precipitous and pathological decline in lung function. Their mean PEFR was decreased by approximately 29 L/min from 373.1 L/min to 342 L/min (t=3.415, p=0.0028) a reduction more than twice as much as that seen in the control group. This statistically significant difference lends validity to recent findings of Upadhyay (2025) as related to respiratory recovery.[19] Upadhyay identified a strong inverse correlation between BMI and post-exercise PEFR recovery in medical undergraduates.[19] According to him, obese individuals showed significant and continued airflow limitation immediately following exercise, while normal-weight individuals rapidly recovered respiratory efficiency.[19] The result of a 29 L/min reduction, therefore, constitutes quantitative evidence that the obese airway is in fact hyper-reactive and prone to severe constriction under physical stress.

EIB prevalence and severity

These levels of EIB also psychologically reinforce how important these PEFR values can be. On the basis of established standards of diagnosis, 12 positive results (40%) were recorded in obese subjects for EIB as opposed to only 3 positive results (10%) for non-obese individuals.[12] These patterns of disease and growth as recognized by Del Giudice et al (2009) are also recognized in the four times higher level of prevalence recorded in obese women.[15] Obese individuals were identified as a principal predictive cause of severity of bronchospasm as remarked by Del Giudice and his team in their analysis of exercise-induced respiratory troubles.[15] Significantly, it is also recognized that the obese subjective complaint of difficult breathing is simply attributed clinically to cardiovascular deconditioning, or simply attributed to lack of fitness, as claimed by Del Giudice.[15] Indeed, his contention of frequent airway blockage is recognized as valid in this study as reflected in positive results of 40%. This means that roughly 50% of young, obese women may have unsuspected EIB. This may lead to avoidance of exercises and a vicious circle of further weight gain and deterioration in respiratory functions.

The Broncho constrictive response in the obese group is most likely due to a complex interaction of the demands of breathing under the influence of systemic inflammation. First of all, the ventilatory demand is substantially greater in obese people. The subjects of Group A required a greater oxygen consumption (VO^2) rate and, accordingly, a greater minute ventilation (VE) because of the necessity of transporting a greater mass of body over the distance of 400 meters. This rapid turnover of large volumes of air leads to excessive evaporation of the airway's superficial fluids. According to the Osmotic Theories of EIB, this leads to an increase in the osmotic concentration of the bronchial epithelium's mucus because of the consequent dehydration of the airway walls.[11] This leads the mast cells of the bronchial wall's mucosa to secrete inflammatory media such as histamine and leukotrienes due to the contraction of the smooth muscles.[11]

Secondly, and more importantly in the context of the current situation, is the fact that it is a low-grade chronic inflammatory disease of a systemic nature.

Shore (2010) describes in great detail the nature of adipocyte's thermogenic/endocrine functionality.[13] It secretes adipokines, also referred to as pro-inflammatory cytokines, such as TNF-alpha, leptin, and interleukin-6 (IL-6).[13] Hyperleptinemia, or hyperleptinemia-induced hyperleptinemia, is demonstrated to have directly enhanced airway smooth muscle contractility while decreasing adiponectin, which is anti-inflammatory in function, according to Shore.[13] This chronic inflammatory state primes the airways in obese subjects to be hyperresponsive to what would otherwise be innocuous stimuli in non-obese subjects.[13] The response of the non-obese subjects to the same 400-meter run was benign, while in the obese subjects, it is pathological due to this biological tendency.

This study has many implications for practice, particularly with respect to weight reduction and physical therapy for patients.

Mandatory screening for obese females: The prevalence rate for obese females being asthmatic is at 40%. It should be mandatory for them to be screened for PEFR in a clinical set-up, prior to and post exercise. This is in accordance with the Global Initiative for Asthma (GINA) norms, according to which there should be objective evaluation of pulmonary function instead of relying on complaints by the patient.[18]

Symptom differentiation by physicians, unfitness vs. obstruction**:** Instead of mere training for endurance, more than 10-15% fall in PEFR.[12]

Weight management: Reducing BMI is essential according to Upadhyay (2025), Shore (2010), Shore & Carlson (2008), to overcome the metabolic and immunological as well as the mechanical stresses involved in EIB.[19,13,21] Therefore, weight management must now be acknowledged as a form of respiratory care.

Certain limitations of the current study should be considered when interpreting the findings. The sample consisted of only 60 participants, which may not be representative of all young girls. The findings cannot be generalized to men since the study included only female participants. The findings cannot be generalized to older people or teenagers because the study included participants of a specific age group only. Only Peak Expiratory Flow Rate was used to assess exercise-induced bronchospasm, spirometry and other more sensitive pulmonary function tests were not used. Only short-term assessment in the form of measurements before and immediately after exercise was conducted, long-term effects were not measured. Bronchospasm was induced by a single pattern of workout, variations in the duration and intensity of exercise were not studied. Moreover, environmental factors that might influence respiratory responses, such as humidity and temperature, were not controlled.

CONCLUSION

The present study conclude that exercise induced bronchospasm is more prevalent in obese young females compared to non-obese females. The risk and severity of EIB increased in obese young females.

From a practical perspective, the study shows that underlying EIB could be responsible for symptoms such as dyspnea in obese females.

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