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A comparative study of body composition and body mass indexs with pefr in elderly males

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Abstract

Background: Pulmonary function in elderly individuals is influenced by multiple physiological and structural changes associated with aging. Body composition parameters such as Body Mass Index (BMI), Waist Circumference (WC), and Waist-Hip Ratio (WHR) are frequently used to assess health status, yet their relationship with lung function, particularly Peak Expiratory Flow Rate (PEFR), remains unclear. Thus, the present study aimed to compare the association between body composition indices and PEFR among healthy and unhealthy elderly males.

Methods: A cross-sectional comparative study was conducted on 168 elderly males aged 60-80 years, divided into two groups Group 1 (healthy, n = 84) and Group 2 (unhealthy, n = 84). Anthropometric measurements (BMI, WC, WHR) and PEFR values were recorded. Data were analyzed using descriptive statistics and Spearman's rank correlation to assess the relationship between body composition indices and PEFR within each group.

Results: The results showed weak and statistically non-significant correlations ($p > 0.05$) between PEFR and all body composition indices in both groups. The mean PEFR was 389 L/min in healthy males and 270 L/min in unhealthy males, demonstrating a 31% further reduction among unhealthy participants.

Conclusion: It was concluded that body composition indices showed no significant association with PEFR in elderly males. Pulmonary function appears to be more influenced by age-related physiological changes, respiratory muscle decline, and other unmeasured confounders rather than by variations in body composition.

Keywords: Body composition, peak expiratory flow rate, elderly males, central adiposity, obesity.

Introduction

In India, a 'senior citizen' or 'older adult' is defined as a person aged 60 years and/or older. This is the fastest growing population in India, increasing from 6.7% in 1991 to 10% in 2021.[1] In older adults, the proportion of body fat, especially abdominal fat, increases with age. Therefore, based on height and weight, body mass index (BMI) measures the changes in body fat. Waist circumference can also be considered for measuring fat distribution. It is widely used to diagnose abdominal obesity and may be a better measure to measure the abdominal obesity in older adults.[7] When it comes to the respiratory system, the natural process of ageing includes muscle imbalances, structural changes in the musculoskeletal system due to geometric modification of the rib cage along with reduction in chest wall compliance. This restricts the mobility of the rib cage and increases the breathing related energy expenditure in the elderly. This leads to increased fatigue and stiffness of respiratory muscles and thus again the pulmonary function is compromised [4].

The respiratory system shows many slow but progressive age related changes in healthy individuals, in lung parenchyma and thoracic cage, and respiratory muscles. These changes include loss of muscle fibres, strength, oxidative capacity, and decreased elastic recoil, leading to reduced ventilatory reserves available.[5] Fat around abdomen / lower thorax limits downward displacement of diaphragm, increases intra-abdominal pressure; also adds load to the thoracic cage making chest wall expansion harder. As age increases, lean mass tends to decline and fat tends to accumulate (especially central fat). Thus body composition changes with age exacerbate lung function decline that would otherwise occur due to ageing alone. [14]

Peak expiratory flow rate is the maximal expiratory flow rate sustained by a subject for at least 10 milliseconds expressed in Litre per minute (L/min). PEFR had been used as measurement of ventilatory capacity for long, mainly because of a much simpler and less tiring procedure than maximum voluntary ventilation (MVV) [6]. Therefore, understanding the impact of age-related changes in body composition, particularly central obesity, on pulmonary function is crucial, as these factors collectively contribute to respiratory compromise in older adults and may be effectively assessed using simple measures like peak expiratory flow rate (PEFR). Considering the progressive physiological and structural changes

Methodology

The present study was a comparative cross-sectional study conducted across various settings in Mumbai and Navi Mumbai, including old-age homes, residential communities, and outpatient physiotherapy clinics. Sampling was performed using a purposive sampling method, and a total of 168 elderly male participants aged between 60 and 80 years were recruited. The sample size was determined using Open Epi software (version 3), keeping the effect size at 0.8 and confidence level at 95%.

Ethical approval for the study was obtained from the Institutional Ethics Committee of Lokmanya Tilak College of Physiotherapy prior to the commencement of data collection. All participants were informed about the purpose and procedure of the study, and written informed consent was obtained. Participant information and collected data were kept strictly confidential throughout the research process.

Eligible participants were screened according to Asia-Pacific classification of BMI and anthropometric measures and then divided into two groups:

Group 1 (Healthy/Control group): Males aged 60-80 years with BMI between 18.5-25 kg/m², waist circumference ≤ 99 cm, and waist-hip ratio ≤ 0.92.

Group 2 (Unhealthy/Obese group): Males aged 60-80 years with BMI ≥ 25 kg/m², waist circumference > 99 cm, and waist-hip ratio > 0.92.

Participants were excluded if they were chronic smokers, had auditory deficits, or presented with major systemic illnesses including musculoskeletal disorders (recent fracture, surgery, or chest deformity), respiratory diseases (COPD, asthma, bronchiectasis, or occupational lung disease), or neurological conditions (Parkinson's disease, stroke, vertigo, dementia, delirium, or Alzheimer's disease). Those with acute infections, recent illness, or who were non-cooperative or unwilling to consent were also excluded.

Statistical Analysis and Results-

The statistical analysis was performed using Microsoft Excel 365 (office). To describe the data, the mean, standard deviation, minimum, and maximum values of BMI, PEFR, WC & WHR were determined. Skewness and kurtosis scores were used to assess the normality of the data distribution. The findings indicated that healthy group - BMI (skewness = -1.05, kurtosis =0.41) PEFR (skewness = -0.05, kurtosis = 0.35) WC (skewness = 1.04, kurtosis = -1.12) WHR (skewness = 0.82, kurtosis = 9.11) were not normally distributed. Because of the non-normal distribution, non-parametric tests were chosen for further examination. Spearman's rank correlation coefficient was used to calculate the association between PEFR and BMI, WC, WHR. The study population was separated into two subgroups healthy and unhealthy based on BMI, WHR &WC: Group A (healthy males = 84) and Group B (unhealthy males = 84). The T-test was used to generate p-value of the intracorrelation of the variables of both the groups. All statistical tests were set with a significance level of $p < 0.05$.

Table 1: The descriptive statistics for PEFR, BMI, WHR & WC are shown in Table 1.

Variable	Mean	SD	Minimum	Maximum
AGE - healthy	66.20	5.16	60	80
unhealthy	69.68	5.88	60	80
BMI - healthy	22.96	1.77	18.4 kg/m2	25 kg/m2
unhealthy	29.27	2.91	25.4kg/m2	37.1kg/m2
WC - healthy	87.59	8.39	72	98
unhealthy	112	9.32	100	133
WHR - healthy	1.976	9.89	0.80	0.91
unhealthy	0.99	0.08	0.92	1.23
PEFR(l/min)- healthy	389.75	79.35	220(L/min)	590(L/min)
unhealthy	270	71.89	160(L/min)	470(L/min)

Table 1. shows the overall descriptive statistics for PEFR, BMI, AGE, WC & WHR among healthy and unhealthy.

The study included 184 elderly males. The sample includes Only males. The descriptive statistics for PEFR, BMI, WHR & WC are shown in Table 1.

The group 1 subjects had a mean BMI of 22.9663, with a range of (18.4kg/m2-5kg/m2) The average PEFR was 389.759 l/min, with a range of (220l/min-590l/min), The average WC 87.59cm with range of (72cm-98cm), The average WHR 1.976 with range of (0.80-0.91) AND group 2 subjects had a mean BMI of 29.277kg/m2, with range of (25.4kg/m2-37.1kg/m2). the average PEFR of 270l/min, with range of (160l/min-470l/min), the average WC of 112.048cm with range of (100cm-133cm) the average WHR 0.999 with average range of (0.92-1.23) Because the data were not normally distributed, the correlation analysis using Spearman's rank

Correlation was done, the correlation revealed that there was no significant relationship between intracorrelation of group 1 and group 2,

Healthy (Group 1) - PEFR & BMI ($r = 0.00$, $p = 0.99$), PEFR & WHR ($r = -0.11$, $p = 0.30$), PEFR & WC ($r = -0.01$, $p = 0.90$) and

Unhealthy (Group 2) - PEFR & BMI ($r = -0.16$, $p = 0.12$) PEFR & WHR ($r = -0.14$, $p = 0.19$) PEFR & WC ($r = -0.22$, $p = 0.03$).

In this study, Spearman's rank correlation was carried out separately for the two groups, namely healthy elderly males (Group 1) and unhealthy elderly males (Group 2), to examine the relationship between body composition parameters and peak expiratory flow rate (PEFR). The analysis within each group showed that the correlations were weak and statistically non-significant, suggesting that variations in BMI, waist circumference, and waist-hip ratio did not meaningfully influence PEFR in either group. When the results of the two groups were compared with each other, the overall pattern remained consistent, with no significant difference emerging between the healthy and unhealthy elderly. Thus, both the within-group and between-group analyses pointed to the same conclusion: body composition indices were not significantly associated with PEFR in elderly males. These findings confirm the null hypothesis of the study and highlight that other factors, such as age-related physiological decline, may play a more dominant role in determining pulmonary function in this population.

Discussion

The present study sought to evaluate and compare the relationship between body composition indices (BMI, waist circumference, and waist-hip ratio) and pulmonary function as measured by peak expiratory flow rate (PEFR) in healthy and unhealthy elderly males. The statistical analysis, performed using Spearman's rank correlation, revealed weak and statistically non-significant associations between PEFR and body composition parameters in both groups. While at first glance this may suggest a limitation, the absence of significant findings carries important clinical and scientific value. It emphasizes that body composition alone cannot reliably predict pulmonary function in elderly males, underscoring the multifactorial nature of respiratory decline in aging populations.

Physiological Factors

Aging brings about progressive and inevitable changes in the respiratory system. With advancing years, lung elastic recoil decreases due to degradation of elastin fibers, chest wall compliance is reduced as a result of calcification and degenerative changes, and respiratory muscle power diminishes due to sarcopenia. These changes collectively impair expiratory flow and reduce PEFR, independent of body composition. Thus, age-related decline appears to be a stronger determinant of pulmonary function than anthropometric measures such as BMI, WC, or WHR. [11]

Respiratory muscle weakness, particularly involving the abdominal and intercostal muscles, further compounds this decline. Since PEFR is highly dependent on the strength of expiratory muscles, elderly individuals with sarcopenia may have poor lung performance irrespective of their body composition. Similarly, diaphragm weakness or restricted excursion—often aggravated by obesity or central adiposity—limits forceful expiration, but in the elderly these effects may be masked by pre-existing structural stiffness of the thoracic cage and kyphotic spinal changes. [11]

PEFR is also known to be an effort-dependent measure, and variability in participant cooperation or stamina introduces additional inconsistencies. Even minor lapses in effort can cause significant variation in recorded values, which may obscure underlying associations. This limitation is particularly relevant in elderly populations where motivational and physical factors are variable. [12]

Mechanical and Anthropometric Limitations

While BMI, waist circumference, and waist-hip ratio are simple, inexpensive tools for estimating body composition, they each have inherent shortcomings. BMI fails to distinguish between fat mass and lean muscle mass, and thus cannot capture the functional relevance of muscle preservation versus fat accumulation. Waist circumference and WHR improve upon BMI by reflecting central adiposity, but they still cannot differentiate between visceral and subcutaneous fat. Since visceral fat has a stronger physiological impact on lung mechanics compared to peripheral fat, this limitation may have blunted the ability to detect significant correlations with PEFR.

Measurement & Effort Dependence -

PEFR is not just a physiological measure—it heavily depends on how fully someone inspires, how forcefully they exhale, and their cooperation and technique. Even with standardized instruction, in elderly populations these small variations in effort can greatly affect readings. Variability in effort (due to fatigue, lack of understanding, or reduced motivation) introduces "noise," masking any subtle correlations with BMI, WC, or WHR. [8]

An Indian study Correlation of Obesity and Peak Expiratory Flow Rate in Young Adult Females found a statistically significant negative correlation between BMI and PEFR ($r = -0.48$, $p < 0.001$). But notably, the study emphasized controlled effort (multiple trials, good instruction) to reach that level of significance. Lack of such controls in elderly cohorts can lead to underestimation of correlation. [8]

Influence of Unmeasured Confounders

Beyond body composition, several unmeasured confounders may have influenced PEFR in the study population. Physical activity level is a crucial determinant of both muscle strength and pulmonary reserve; sedentary individuals are more likely to have reduced PEFR regardless of their BMI. [9] Occupational exposures such as dust, fumes, or industrial pollutants may impair lung function independent of obesity. Nutritional status affects both respiratory muscle efficiency and body composition, where deficiencies can lead to muscle wasting even in individuals with normal BMI. Furthermore, subclinical pulmonary and cardiovascular diseases—common in elderly males—can silently reduce PEFR without overt changes in body composition indices. Long-term smoking history and environmental pollution also contribute to irreversible airway damage and reduced expiratory flow. Collectively, these confounders may have diluted or masked potential associations between BMI, WC, WHR, and PEFR, explaining the absence of significant findings. [10]

Factors Affecting Individual Parameters

Peak Expiratory Flow Rate (PEFR) tends to decline naturally with advancing age due to multiple physiological and environmental factors. The loss of lung elasticity, stiffening of the chest wall, and weakening of respiratory muscles caused by sarcopenia collectively reduce expiratory capacity. Inefficient diaphragmatic movement, coupled with chronic exposure to air pollutants or smoking, further compromises airway function. Moreover, since PEFR is an effort-dependent measure, variations in participant cooperation or stamina—especially in elderly individuals—can contribute to inconsistent results.

Waist circumference (WC) and waist-hip ratio (WHR) are largely influenced by abdominal obesity and central adiposity, both of which increase the load on the diaphragm and reduce lung expansion. Genetic and hormonal factors, such as altered fat distribution patterns with age, also play a key role. Additionally, a sedentary lifestyle promotes accumulation of fat around the abdomen, elevating WC and WHR without necessarily reflecting muscle health or respiratory efficiency.

Similarly, Body Mass Index (BMI) is affected by several factors including dietary habits, physical inactivity, and lifestyle behaviors such as smoking and alcohol consumption. With aging, a natural decline in basal metabolic rate often contributes to gradual weight gain, while certain medications—like corticosteroids—may cause further increases in body weight. Fluid retention or edema can also lead to an overestimation of BMI, thereby misclassifying an individual's nutritional or health status.

Clinical Research Implications and suggestions -

Though statistically non-significant, the findings offer valuable clinical insight. They indicate that anthropometric indices alone cannot predict pulmonary function in elderly males, underscoring the need for direct lung testing and respiratory assessment. Clinically, this supports integrating pulmonary screening, respiratory muscle training, and lifestyle modification into geriatric care. Future research should include broader lung parameters (FEV_1, FVC), advanced body composition tools, and interventions like exercise and nutrition programs to preserve lung health in the elderly.

Regular yoga practice, including pranayama and asanas, improves lung compliance, strengthens respiratory muscles, and enhances PEFR. An Indian study (Rajendran et al., 2021) reported significant gains in PEFR after eight weeks of yoga training, suggesting that consistent yogic breathing can effectively support respiratory health in the elderly. [22]

Conclusion and Future Directions-

This study highlights that while body composition indices (BMI, WC, WHR) showed no significant correlation with PEFR, age-related physiological changes and respiratory muscle strength play a more influential role in pulmonary function among elderly males. These findings emphasize the importance of respiratory training, muscle strengthening, and advanced assessment methods in future research to enhance lung health in the aging population.

References

1. Dsouza SA, et al. Falls in Indian older adults: a barrier to active ageing. Asian Journal of Gerontology and Geriatrics,2014;9(1):19-25.
2. Houston DK, et al. Weighty concerns: the growing prevalence of obesity among older adults. Journal of the American Dietetic Association,2009;109(11):1886-1895.
3. Mistry H, et al. Respiratory muscle stretch gymnastics in elderly: impact on maximum breathing capacity, peak expiratory flow rate and exercise capacity. International Journal of Health Sciences and Research,2020;10(3):63-68.
4. Awachat AC, Sahasrabudhe P, Sancheti P, et al. Effect of respiratory muscle stretch gymnastics on exercise capacity in the elderly - a randomized control trial. Indian Journal of Respiratory Care,2022;11(2):189-195.
5. Datta S, Kumar A, Sinha R, Ghosh P. Establishing normative values of peak expiratory flow rate in Indian population: a cross-sectional study in Jharkhand. Indian Journal of Applied Research,2024;14(2):56-60.
6. Shanmugasundaram K, Bade G, Sampath M, Talwar A. Effect of obesity on airway mechanics. Indian Journal of Endocrinology and Metabolism,2023;27(3):200-205.
7. Satapathy AK, Mishra AK, Patel S, Tripathy R. Effect of body mass index on pulmonary functions in children: a cross-sectional study. Journal of Clinical and Diagnostic Research,2022;16(4):CC10-CC14.
8. Shah H, Patel P, Dave R, Chaudhary S. Effect of body mass index on cardiorespiratory parameters in medical students of Zydus Medical College, Gujarat. National Journal of Physiology, Pharmacy and Pharmacology,2022;12(8):1052-1056.
9. Mankar K, Sunitha M, Dindugala R. Effect of age, gender, and body mass index on pulmonary function test parameters in healthy individuals. National Journal of Physiology, Pharmacy and Pharmacology,2022;12(5):607-612.
10. Wu Z, et al. Performance testing for different peak expiratory flow meters. Journal of Pulmonary Medicine,2022;9(3):211-217.
11. Rajendran P, Madanmohan, Gaur GS, Gaur A. Effect of yoga training on autonomic and lung function tests in normal young volunteers. International Journal of Health and Clinical Research,2021;4(17):5-10.
12. Pavana B, Bhavya Shree P. Correlation of obesity and peak expiratory flow rate in young adult females. Indian Journal of Physiotherapy and Occupational Therapy,2020;14(2):231-236.
13. Rai RH, Kumar N, Singh S. Relationship of peak expiratory flow rate with waist circumference, hip circumference, and waist-hip ratio among Indian adults. International Journal of Physiology,2020;8(3):45-50.
14. Van Zeller M, et al. Comparison of bench test results measuring the accuracy of peak flow meters. Respiratory Care Journal,2019;64(12):1508-1514.
15. Anjum A, et al. Correlation of peak expiratory flow rate with body mass index in men of age group 25-40 years at RIMS, Raichur. Indian Journal of Clinical Anatomy and Physiology,2016;3(2):106-107.
16. Bhardwaj P, et al. Effects of age and body mass index on peak expiratory flow rate in Indian population. Indian Journal of Physiology and Pharmacology,2014;58(2):166-169.
17. Ozturk AB, Kavya Z, Erkan F. Reliability of peak expiratory flow measurement in assessing bronchodilator response of airflow obstruction. Journal of Asthma and Allergy Education,2010;1(4):150-154.
18. Chakraborty P, Bhattacharya S, Pattanaik S, Ray A, Saha M. Abdominal obesity and pulmonary functions in young Indian adults: a prospective study. Indian Journal of Physiology and Pharmacology,2010;54(2):152-156.
19. Chen MM, et al. Intraobserver and interobserver reliability of waist circumference and the waist-to-hip ratio. Obesity Reviews,2012;9(10):651-656.