EFFECT OF OBESITY AND OVERWEIGHT ON PEAK EXPIRATORY FLOW RATE (PEFR) AMONG PHYSIOTHERAPY STUDENTS

A Cross Sectional Observational Study

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Abstract: Obesity and overweight are emerging health concerns affecting respiratory function in young adults. This study aimed to determine the effect of obesity and overweight on peak expiratory flow rate (PEFR) among physiotherapy students and to examine the relationship between body mass index (BMI) and pulmonary function. A cross-sectional observational study was conducted with 100 physiotherapy students (53% female, 47% male) aged 18-25 years, comprising 43 overweight and 57 obese class I participants. PEFR was measured using Wright's portable peak flow meter, and BMI was calculated from measured height and weight. Data were collected using a standardized questionnaire assessing demographic information, air pollution exposure, and physical activity levels. The mean PEFR for overweight students was 364.93 ± 15.8 L/min, which was significantly higher than the obese class I group (328.49 ± 17.5 L/min) with a statistically significant difference ($t = 6.24$, $p < 0.001$). A Pearson correlation analysis revealed a moderate negative correlation between BMI and PEFR ($r = -0.61$), indicating that as BMI increases, PEFR decreases. Physical activity analysis demonstrated that regularly active students had the highest PEFR (365.2 ± 15.6 L/min), followed by occasionally active (334.8 ± 17.2 L/min), and inactive students (310.6 ± 18.4 L/min), with statistically significant differences ($p < 0.05$). The findings conclude that obesity and overweight significantly reduce peak expiratory flow rate in physiotherapy students, while regular physical activity helps improve respiratory function. These results highlight the importance of maintaining a healthy BMI and engaging in regular physical activity to preserve optimal pulmonary function in young adults.

Index Terms - Obesity, Overweight, Peak Expiratory Flow Rate, Body Mass Index, Physical Activity, Respiratory Function, Physiotherapy Students

Introduction

Overweight and obesity represent conditions characterized by excessive body fat accumulation that poses significant health risks[1] . According to the World Health Organization (WHO), approximately 16% of adults aged 18 years and older worldwide were obese in 2022, with global obesity rates more than doubling between 1990 and 2022. This escalating prevalence constitutes a major public health challenge associated with substantial economic burden and adverse health outcomes.

Obesity serves as a primary risk factor for numerous non-communicable diseases, including cardiovascular disease, stroke, type 2 diabetes mellitus, and various malignancies such as endometrial, breast, ovarian, prostate, liver, gallbladder, kidney, and colon cancers. Additionally, obesity contributes to osteoarthritis, reduced occupational productivity, and significant social complications. Projections suggest that if current trends continue, nearly half of the global population will be overweight or obese by 2030[2][3]

The epidemic of obesity, coupled with increasing rates of cardiovascular disease and diabetes, represents a critical global health concern. Obesity accounts for approximately 2.6 million deaths annually worldwide, with prevalence increasing across all age groups and geographic regions[4][5] . In pediatric populations, over 22 million children under age 20 are obese, with one in ten classified as overweight. In India specifically, studies have documented obesity rates of 7.4% in Delhi and 6.2% in Chennai among children[6] . Research among college students in Karnataka revealed overweight prevalence of 9.9% and obesity prevalence of 4.8%[7].

Obesity exerts profound effects on the respiratory system, causing airway dysfunction, pulmonary complications, increased infection susceptibility, and potential cardiac failure[8]. Physical activity plays a crucial protective role by reducing total body fat accumulation, attenuating abdominal obesity progression, and improving cardiovascular and metabolic health parameters. Current recommendations suggest young adults engage in at least 60 minutes of vigorous exercise daily to counteract sedentary lifestyle effects[9][10] . The primary etiological factors contributing to obesity include excessive consumption of high-calorie foods and insufficient physical activity.

Peak Expiratory Flow Rate (PEFR) represents the maximum velocity of airflow during forced expiration, measured using a peak flow meter[11] . This parameter, typically expressed in liters per minute (L/min), provides an objective assessment of airflow limitation and demonstrates significant reduction in obstructive pulmonary diseases[12][13]. PEFR measurement offers valuable clinical utility in asthma management and monitoring of exacerbations[15].

Multiple factors influence PEFR in healthy individuals. Body composition parameters demonstrate complex relationships with PEFR: values increase with height, weight, and body surface area, but decrease with elevated Body Mass Index (BMI)[16][17]. PEFR exhibits age-related variation, increasing throughout childhood and adolescence before declining after 30-40 years of age. Gender differences are consistently observed, with males demonstrating higher PEFR values than females [18][19].

Environmental and lifestyle factors additionally impact PEFR. Pediatric populations in rural areas typically exhibit higher PEFR values compared to urban counterparts. Pulmonary elasticity, expiratory muscle strength, and force of expiration directly determine PEFR measurements. The effort-dependent nature of PEFR testing necessitates maximum voluntary effort during measurement procedures.[20,21]

Need for the Study

The escalating prevalence of obesity across all age demographics necessitates comprehensive understanding of its impact on respiratory function, as compromised pulmonary capacity significantly diminishes quality of life and increases morbidity risk. Obesity demonstrates established associations with multiple respiratory complications including asthma, obstructive sleep apnea, and chronic obstructive pulmonary disease (COPD). Investigation of obesity's effect on PEFR elucidates mechanisms whereby excessive body weight impairs respiratory mechanics and reduces lung capacity. Diminished PEFR compromises physical activity tolerance, causes dyspnea, and elevates susceptibility to respiratory infections and chronic diseases.

Understanding these relationships facilitates development of targeted prevention and management strategies for obesity-related respiratory complications. Student populations, particularly physiotherapy students, frequently adopt sedentary lifestyles with limited physical activity opportunities due to academic demands. This study aims to characterize the relationship between overweight/obesity and PEFR among physiotherapy students, enabling implementation of appropriate preventive interventions to protect pulmonary health in this vulnerable population.

Aim and Objectives

Aim

- To study the effect of obesity and overweight on peak expiratory flow rate among physiotherapy students

Objectives

- To determine the correlation between body mass index and PEFR values in the study population using Peak Expiratory Flow Questionnaire

Review of Literature

Borse et al. (2014) investigated the effect of body weight on PEFR in 78 healthy male first-year medical students aged 18-22 years. While differences in PEFR were not definitively established, the study suggested that overweight status may alter respiratory muscle function, airway dimensions, breathing resistance, and respiratory chemical processes, potentially explaining reduced PEFR values in overweight individuals[22].

Jena et al. (2017) examined the relationship between PEFR and BMI in young adults aged 18-24 years. Mean PEFR values were 498 L/min, 488 L/min, and 391 L/min for normal weight, overweight, and obese males respectively. For females, corresponding values were 377 L/min, 348 L/min, and 325 L/min. The study demonstrated negative correlations between BMI and PEFR in both males (r=-0.512) and females (r=-0.539), concluding that PEFR decreases with increasing BMI [23].

Pavana et al. (2020) conducted a correlational study investigating obesity and PEFR in young adult females. The research emphasized that pulmonary function depends on respiratory muscle strength, thoracic cavity compliance, airway resistance, and lung elasticity. Obesity was noted to compromise diaphragmatic and thoracoabdominal muscle function. The study documented that obesity prevalence among Indian women increased from 10.6% to 12.6%, representing a 24.52% rise. A negative correlation between BMI and PEFR was confirmed in young adult females [24].

Mistry et al. (2023) examined PEFR differences between males and females across weight status categories. The study included 160 participants (80 males, 80 females) categorized by BMI into underweight, normal weight, overweight, and obese groups. Data

collection occurred two hours postprandially following 15 minutes of rest. Males demonstrated significantly higher PEFR values compared to females in underweight, normal weight, and overweight categories. Positive correlations between BMI and PEFR were observed in underweight individuals of both genders, normal weight males, overweight females, and obese females, though statistical significance was achieved only in obese individuals [25].

Agrawal et al. (2019) investigated prevalence and determinants of obesity and overweight among college students in Gujarat, India. This cross-sectional study conducted between April 2017 and March 2018 included 1330 students aged 18-23 years from randomly selected colleges. Using International Obesity Task Force guidelines, the study identified associations between overweight/obesity and sedentary behavior (>2 hours daily screen time), excessive caloric intake, and frequent junk food consumption. Data analysis utilized SPSS 17 software. The research concluded that obesity and overweight correlate with reduced PEFR, potentially affecting respiratory function in healthy young adults. Early detection and intervention could prevent future pulmonary complications and improve overall health and functional capacity [26].

Kundavarum et al. (2023) assessed obesity prevalence among undergraduate medical students at a tertiary care hospital in Nandyal. This cross-sectional study of first, second, and third-year medical students revealed 20% overweight prevalence and 8% obesity prevalence. The majority of students demonstrated insufficient physical activity and poor dietary habits, including excessive fast food consumption and frequent meal skipping. BMI correlated with lifestyle factors including physical inactivity, high fast food intake, eating while viewing screens, and family obesity history. These findings reflect concerning trends consistent with reports of increasing obesity among adolescents and young adults, particularly medical students in India[27].

Dhungel et al. (2008) measured PEFR in healthy Nepalese children and young adults. The study included 196 participants selected from schools and colleges in Pokhara, Nepal, based on specific inclusion and exclusion criteria. Standardized methods assessed anthropometric data and PEFR. Height demonstrated significant influence on PEFR, while weight showed no significant effect. The investigators developed a prediction equation enabling PEFR estimation for Nepalese individuals aged 5-25 years based on age and height [28].

Joshi et al. (2016) conducted a correlational study examining BMI effects on PEFR in 40 healthy adults aged 18-35 years. Participants were stratified into Group A (normal BMI: 18.5-22.9 kg/m²) and Group B (obese BMI: ≥25 kg/m²). Each participant performed three PEFR measurements in seated position, with the best value recorded. The study established a positive correlation between BMI and PEFR, emphasizing the importance of identifying at-risk individuals before disease manifestation [29].

Shenoy et al. (2014) investigated adiposity's impact on PEFR in 186 healthy young adult South Indian females aged 18-22 years. Participants were categorized according to WHO BMI classifications. Data analysis employed ANOVA and Pearson's correlation test. Results demonstrated that obesity and body fat distribution patterns independently affect PEFR in young females. Abdominal adiposity was noted to compromise pulmonary function by restricting diaphragmatic movement and limiting lung expansion[30].

Babu et al. (2014) performed a comparative study of PEFR and BMI in 150 healthy male and female medical students following informed consent. Basic parameters including blood pressure, weight, and height were measured, with BMI calculated using Quetelet's formula. PEFR was assessed using Wright's Peak Flow Meter. The study concluded that males exhibited higher PEFR values than females, and that body fat accumulation correlates with reduced PEFR[31].

Popat et al. (2023) investigated physical activity levels and obesity prevalence among 176 undergraduate physiotherapy students aged 18-25 years in Navi Mumbai. Results indicated 29% high physical activity level, 48% moderate level, and 23% low level. BMI distribution revealed 18% in obesity class I, 6% in obesity class II, and 17% at high risk for obesity. The findings highlighted concerns regarding weight gain and physical inactivity contributing to chronic health problems[32].

Hanon (2021) examined peak inspiratory and expiratory flow reliability and reference values in 187 healthy adults aged 20-80 years. The study, conducted across three separate days with subgroup analysis, aimed to establish reliable peak inspiratory flow (PIF) measurements and develop reference equations. Valid PIF measurements required an average of 3.3±0.6 attempts, with within-test variability of 4.6±3.2%. Commencing with slow expiration before forced inspiration produced a modest but significant 2.5% PIF increase. Inter-individual PIF differences across the age range were smaller than previously reported. PIF prediction based on gender, age, and height yielded R^2=0.53. The study concluded that adherence to ATS/ERS guidelines for effort-dependent spirometric measurements enables reliable PIF and PEF values suitable for clinical application[33,34].

Hypothesis

Null Hypothesis (H_0)

There is no statistically significant difference in Peak Expiratory Flow Rate (PEFR) between overweight and obese Class I physiotherapy students, and no significant correlation exists between physical activity levels and PEFR.

Alternative Hypothesis (H_1)

There is a statistically significant difference in Peak Expiratory Flow Rate (PEFR) between overweight and obese Class I physiotherapy students, and a significant correlation exists between physical activity levels and PEFR.

Methodology

Study Design

This investigation employed an observational cross-sectional study design.

Study Setting

The research was conducted at TMV's Jayantrao Tilak College of Physiotherapy, Pune, Maharashtra, India.

Sample Size

A total of 100 physiotherapy students were recruited using convenient sampling methodology.

Materials and Equipment

- Wright's Portable Peak Flow Meter
- Measuring tape (anthropometric)
- Calibrated weighing scale
- Informed consent forms
- Peak Expiratory Flow Rate questionnaire

Inclusion Criteria

1. Physiotherapy students aged 18-25 years
2. Both male and female undergraduate students
3. Students classified as overweight or obese according to WHO BMI criteria:
    - Overweight: BMI 25.0-29.9 kg/m²
    - Obese Class I: BMI 30.0-34.9 kg/m²
4. Willing to provide informed consent

Exclusion Criteria

1. Students with diagnosed respiratory conditions (asthma, COPD, bronchitis, or other airflow-limiting disorders)
2. Current or former smokers (occasional or regular)
3. Students classified as underweight (BMI <18.5 kg/m²) or normal weight (BMI 18.5-24.9 kg/m²) according to WHO criteria
4. Individuals with mechanical obstruction preventing test performance
5. Individuals with oral lesions or abnormalities precluding proper mouthpiece seal
6. Recent respiratory tract infection (within 2 weeks)

Outcome Measures

- Body Mass Index (BMI) calculated as weight (kg) divided by height squared (m²)
- Peak Expiratory Flow Rate (PEFR) measured in liters per minute (L/min)
- Physical activity level assessed via standardized questionnaire
- Air pollution exposure documented via self-report

Procedure

Following institutional ethical approval, potential participants were approached and provided comprehensive information regarding study objectives, procedures, risks, and benefits. Written informed consent was obtained from all participants prior to enrollment.

Demographic data including age, gender, height, and weight were recorded. BMI was calculated using standard formula: BMI = weight (kg) / height² (m^2). Participants were categorized as overweight (BMI 25.0-29.9 kg/m^2) or obese Class I (BMI 30.0-34.9 kg/m^2) according to WHO classification.

PEFR Measurement Protocol

PEFR assessment was performed using Wright's Portable Peak Flow Meter following standardized procedure:

1. The measurement technique was demonstrated to each participant
2. Participants were provided opportunity for practice attempts to ensure proper technique comprehension
3. The peak flow meter marker was positioned at zero
4. Participants assumed standing position and inhaled maximally
5. Participants placed lips firmly around the mouthpiece, ensuring airtight seal with no air leakage
6. Participants exhaled as forcefully and rapidly as possible
7. The reading was recorded at the marker's final position
8. Three consecutive measurements were obtained with 1-2 minute rest intervals between attempts
9. The highest of three readings was recorded (not the mean value)
10. Measurement consistency was verified, accepting variations ≤5% between attempts

Questionnaire Administration

A validated four-section self-administered questionnaire was completed by all participants, assessing:

- Air pollution exposure (yes/no)
- Physical activity engagement and frequency
- Exercise type and duration
- Demographic characteristics

All data were systematically collected, recorded on standardized data collection sheets, and prepared for statistical analysis.

Data Analysis

All statistical analyses were performed using GraphPad InStat (Trial Version 3.0632). Descriptive statistics included mean, standard deviation (SD), frequencies, and percentages. Independent samples t-test compared mean PEFR values between overweight and obese Class I groups. Pearson correlation coefficient assessed the relationship between BMI and PEFR. One-way ANOVA evaluated PEFR differences across physical activity levels. Statistical significance was established at $p<0.05$ with 95% confidence interval.

Demographic Characteristics

Age Group (Years)	Count (n)	Percentage (%)
20-22	39	39%
23-25	61	61%

Table 1: Distribution of participants by age groups

The majority of participants (61%) were aged 23-25 years, while 39% belonged to the 20-22 years age group.

Gender	Count (n)	Percentage (%)
Female	53	53%
Male	47	47%

Table 2: Distribution of participants by gender

The study sample demonstrated relatively balanced gender distribution with 53% females and 47% males.

Weight Status	Count (n)	Percentage (%)
Obese Class I	57	57%
Overweight	43	43%

Table 3: Distribution of weight status categories

The majority of participants (57%) were classified as Obese Class I (BMI 30.0-34.9 kg/m²), while 43% were categorized as overweight (BMI 25.0-29.9 kg/m²). This distribution indicates high prevalence of excess weight within the study population, directly relevant to the research objectives.

Environmental Exposure

Air Pollution Exposure	Count (n)	Percentage (%)
Yes	100	100%
No	0	0%

Table 4: Air pollution exposure distribution

All participants (100%) reported exposure to air pollution, primarily attributable to daily commuting and environmental factors in the urban setting.

PEFR Measurements by Weight Status

PEFR Attempt	Overweight (Mean ± SD)	Obese Class I (Mean ± SD)
1st Attempt	352.28 ± 18.3 L/min	313.30 ± 20.1 L/min
2nd Attempt	356.44 ± 17.9 L/min	315.00 ± 19.4 L/min
3rd Attempt	357.21 ± 16.7 L/min	320.60 ± 18.9 L/min
Best PEFR	364.93 ± 15.8 L/min	328.49 ± 17.5 L/min

Table 5: Comparison of mean PEFR values between overweight and obese Class I participants across attempts

Overweight participants consistently demonstrated higher PEFR values across all measurement attempts compared to obese Class I participants. The best PEFR values were 364.93 ± 15.8 L/min for overweight and 328.49 ± 17.5 L/min for obese Class I participants, representing a mean difference of 36.44 L/min. This consistent pattern indicates that increased body weight, specifically obesity, associates with reduced pulmonary function performance as reflected by lower PEFR values.

Statistical Comparison of PEFR Between Groups

Parameter	Overweight	Obese Class I	t-value	p-value	Significance
Mean PEFR (L/min)	364.93 ± 15.8	328.49 ± 17.5	6.24	<0.001	Significant

Table 6: Independent samples t-test comparing mean PEFR between weight status groups

Independent samples t-test revealed statistically significant difference in mean PEFR between overweight and obese Class I participants ($t=6.24$, $p<0.001$). The overweight group's mean PEFR (364.93 L/min) exceeded that of the obese Class I group (328.49 L/min) by 36.44 L/min, representing a clinically meaningful difference. This finding indicates that increasing BMI adversely affects respiratory function, with obesity demonstrating greater negative impact on pulmonary capacity compared to overweight status.

Correlation Between BMI and PEFR

Variable Pair	Pearson Correlation (r)	Interpretation
BMI vs PEFR	-0.61	Moderate negative correlation

Table 7: Correlation analysis between BMI and PEFR

Pearson correlation analysis demonstrated a moderate negative correlation ($r=-0.61$) between BMI and PEFR, indicating inverse relationship whereby PEFR decreases as BMI increases. This correlation confirms that higher body mass index impairs expiratory airflow capacity, supporting the hypothesis that obesity negatively affects pulmonary function. The accumulation of adipose tissue, particularly in thoracic and abdominal regions, restricts chest wall compliance, diaphragmatic excursion, and lung expansion, thereby increasing airway resistance and reducing expiratory flow rates.

Discussion

This observational cross-sectional study investigated the relationship between obesity, overweight status, and Peak Expiratory Flow Rate among physiotherapy students, additionally examining physical activity's influence on pulmonary function. All statistical analyses were conducted using GraphPad InStat (Trial Version 3.0632), with results presented as mean ± standard deviation, t-values, p-values, and correlation coefficients.

The primary finding demonstrated significantly higher mean PEFR in overweight participants (364.93 ± 15.8 L/min) compared to obese Class I participants (328.49 ± 17.5 L/min). Independent samples t-test confirmed this difference as highly statistically significant ($t=6.24$, $p<0.001$), leading to rejection of the null hypothesis. The alternative hypothesis was accepted, establishing that BMI elevation correlates with PEFR reduction. This relationship is physiologically explicable through multiple mechanisms: increased adipose tissue deposition in thoracic and abdominal regions reduces chest wall compliance, restricts diaphragmatic excursion, limits lung expansion capacity, and elevates airway resistance. These biomechanical alterations collectively compromise expiratory airflow, manifesting as reduced PEFR values in obese individuals relative to overweight counterparts[35][36][37].

Pearson correlation analysis yielded a moderate negative correlation coefficient ($r=-0.61$) between BMI and PEFR, quantitatively demonstrating that expiratory flow rate decreases proportionally with BMI increase. This inverse relationship reflects the cumulative effects of adiposity on respiratory mechanics: thoracoabdominal adipose accumulation impairs diaphragmatic mobility, diminishes thoracic cage compliance, and increases airway resistance. These pathophysiological changes reduce pulmonary capacity for rapid air expulsion, consequently lowering PEFR measurements.

The present study's findings align consistently with previous research. Jena et al. (2017) reported strong inverse correlations between BMI and PEFR among young adults, supporting the current results[23]. Pavana et al. (2020) documented reduced dynamic lung volumes including PEFR and FEV1 in obese individuals, attributing these changes to obesity's mechanical effects on respiratory function[24]. Similarly, Mistry et al. (2023) identified lower PEFR values in obese participants compared to normal weight individuals[25]. This concordance across multiple independent investigations strengthens confidence in the present study's conclusions regarding obesity's detrimental impact on pulmonary function.

Physical activity analysis revealed significant PEFR variations across activity levels. Participants were stratified into regularly active (≥30 minutes daily), occasionally active (<30 minutes daily), and inactive categories. Mean PEFR values were 365.2 ± 15.6 L/min, 334.8 ± 17.2 L/min, and 310.6 ± 18.4 L/min respectively. One-way ANOVA demonstrated statistically significant differences between groups ($p<0.05$), indicating regular physical activity enhances pulmonary efficiency. Exercise-induced improvements stem

from multiple adaptive mechanisms: strengthening of respiratory musculature, increased pulmonary compliance, enhanced ventilation-perfusion matching, and improved overall cardiorespiratory fitness. These adaptations collectively optimize expiratory airflow capacity, manifesting as elevated PEFR values.

These physical activity findings corroborate research by Kumar et al. (2019) and Singh et al. (2021), who documented significantly higher PEFR and vital capacity in physically active young adults compared to sedentary counterparts. Regular exercise promotes respiratory muscle endurance, thoracic expansion capacity, and pulmonary ventilation efficiency, culminating in superior lung function[12][13].

The present investigation establishes two critical relationships: (1) a negative correlation between BMI and PEFR (r=-0.61), demonstrating that increased body weight compromises pulmonary function, and (2) a positive association between physical activity and PEFR, indicating regular exercise enhances respiratory capacity. These findings validate the study's hypotheses that obesity impairs PEFR while regular physical activity improves expiratory performance. The results underscore the importance of maintaining healthy BMI and engaging in consistent physical activity to optimize pulmonary function and mitigate obesity-related respiratory complications.

PEFR measurement emerges as a simple, cost-effective, and reliable tool for assessing pulmonary function across BMI categories. Regular PEFR monitoring facilitates early detection of respiratory capacity reduction, enabling timely preventive interventions through weight management and lifestyle modification. The present study confirms significant PEFR reduction with increasing BMI and establishes positive correlation between regular physical activity and elevated PEFR values. These findings align with existing literature and emphasize the necessity of maintaining healthy body weight and engaging in regular physical activity to ensure optimal pulmonary function among physiotherapy students and young adult populations.

Results and Conclusion

Results

This observational cross-sectional study examined 100 physiotherapy students to assess obesity and overweight effects on Peak Expiratory Flow Rate and physical activity's influence on pulmonary function. Participants were stratified by Body Mass Index into overweight (n=43, BMI 25.0-29.9 kg/m²) and obese Class I (n=57, BMI 30.0-34.9 kg/m²) groups.

Demographic analysis revealed 61% of participants aged 23-25 years and 39% aged 20-22 years. Gender distribution was balanced with 53% females and 47% males. BMI classification showed 57% in obese Class I category and 43% overweight. Universal air pollution exposure (100%) was reported, primarily attributable to daily commuting and urban environmental factors.

Physical activity assessment categorized 46% as regularly active (≥30 minutes daily exercise), 35% as occasionally active, and 19% as inactive. Mean PEFR for overweight participants measured 364.93 ± 15.8 L/min, significantly exceeding obese Class I participants' mean of 328.49 ± 17.5 L/min. Independent samples t-test confirmed highly significant difference ($t=6.24$, $p<0.001$), establishing inverse relationship between BMI and PEFR.

Correlation analysis demonstrated moderate negative correlation (r=-0.61) between BMI and PEFR, confirming that increased body mass index associates with reduced expiratory flow rate. This relationship reflects biomechanical effects of adiposity on respiratory mechanics.

Comparative analysis established overweight participants demonstrated superior PEFR relative to obese Class I participants. Regular physical activity correlated positively with respiratory function enhancement. All statistical analyses employed GraphPad InStat (Trial Version 3.0632) with significance established at 95% confidence level ($p<0.05$).

The study conclusively demonstrated that increased BMI reduces PEFR, while regular physical activity improves pulmonary function, supporting the alternative hypothesis that obesity adversely affects pulmonary capacity among physiotherapy students.

Conclusion

This investigation aimed to determine obesity and overweight effects on Peak Expiratory Flow Rate and physical activity's influence on pulmonary function in physiotherapy students. Results conclusively establish that obesity exerts significant negative impact on PEFR, while regular physical activity enhances respiratory capacity.

Mean PEFR for overweight participants significantly exceeded that of obese Class I participants , with highly significant statistical difference ($t=6.24$, $p<0.001$). Pearson correlation analysis revealed moderate inverse relationship (r=-0.61) between BMI and PEFR, confirming that elevated BMI correlates with reduced expiratory airflow capacity.

Physical activity analysis demonstrated participants engaging in regular exercise (≥30 minutes daily) achieved highest PEFR values, while sedentary individuals exhibited lowest measurements, with statistically significant differences ($p<0.05$). All statistical computations utilized GraphPad InStat (Trial Version 3.0632).

Study findings support the hypothesis that obesity compromises pulmonary function, while regular physical activity enhances respiratory performance through strengthening respiratory musculature and increasing thoracic mobility. Maintaining healthy body weight and engaging in consistent physical activity constitute essential strategies for preserving pulmonary health and preventing obesity-related respiratory complications.

Early identification of reduced PEFR enables physiotherapists to implement preventive interventions and promote healthier, more active lifestyles among young adult populations. Regular PEFR monitoring should be integrated into health screening protocols for overweight and obese individuals to facilitate timely detection of respiratory function decline and enable appropriate therapeutic interventions.

Limitations

1. Sample size of 100 participants may not provide comprehensive representation of all physiotherapy students or diverse age demographics, potentially limiting generalizability of findings
2. BMI stratification included only overweight and obese Class I categories, excluding normal weight, underweight, and severe obesity classifications (Classes II and III), restricting applicability across full weight spectrum
3. Air pollution exposure assessment relied on self-reported data rather than objective environmental measurements, potentially introducing reporting bias and measurement inaccuracy
4. PEFR measurement employed single device type and depended on participant effort, with potential variations in technique compliance and exertion levels affecting result reliability
5. Study population exclusively comprised young adult physiotherapy students, precluding generalization to other age groups or individuals with pre-existing medical conditions
6. Cross-sectional study design prevents establishment of causal relationships or temporal associations between obesity and PEFR decline
7. Lack of longitudinal follow-up precludes assessment of PEFR changes over time or evaluation of intervention effects on pulmonary function
8. Study did not control for potential confounding variables including dietary patterns, sleep quality, stress levels, or genetic predisposition to obesity
9. Seasonal variations in air quality and their potential effects on PEFR were not systematically evaluated

Future Scope

1. Future investigations should employ larger, more demographically diverse samples encompassing multiple age groups, occupational categories, and geographic locations to enhance generalizability of findings
2. Research should include comprehensive BMI stratification encompassing underweight, normal weight, overweight, and all obesity classifications (Classes I, II, and III) to characterize complete spectrum of body weight effects on pulmonary function
3. Longitudinal studies or controlled intervention trials examining weight reduction and structured exercise programs could elucidate temporal relationships and quantify PEFR improvements following lifestyle modifications
4. Comparative effectiveness research should investigate various physical activity modalities including aerobic exercise, resistance training, yoga, and respiratory muscle training to identify optimal interventions for PEFR enhancement
5. Comprehensive multifactorial studies should examine dietary patterns, sleep quality, psychological stress, and genetic factors influencing respiratory health in young adults, enabling holistic understanding of pulmonary function determinants
6. Objective environmental monitoring systems should replace self-reported air pollution exposure assessment to provide accurate quantification of environmental respiratory insults
7. Studies should incorporate multiple pulmonary function parameters including forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and FEV1/FVC ratio alongside PEFR for comprehensive respiratory assessment
8. Investigation of obesity's effects on exercise tolerance, dyspnea perception, and quality of life measures would provide clinically relevant functional outcomes beyond physiological measurements

9. Research examining cost-effectiveness of PEFR screening programs in young adult populations could inform public health policy regarding respiratory health monitoring

10. Development and validation of predictive models incorporating BMI, physical activity, environmental exposures, and demographic factors could enable individualized risk assessment for respiratory function decline

11. Exploration of technology-enabled interventions including mobile health applications, wearable activity monitors, and telemedicine platforms for promoting weight management and physical activity adherence warrants investigation

12. Studies examining respiratory muscle strength training as targeted intervention for improving PEFR in overweight and obese individuals could provide novel therapeutic approaches

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