

Correlation between Peak Expiratory Flow Rate (PEFR) and Exercise-Induced Breathlessness (EIB) in Normal Young Adults

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Abstract

Background: Peak Expiratory Flow Rate (PEFR) is a fundamental measure of lung function and airway caliber. Physical exercise induces respiratory dynamic changes that can cause transient bronchoconstriction in susceptible individuals. Assessing PEFR changes before and after exercise provides key insights into respiratory physiological adaptations and early markers of exercise-induced bronchoconstriction.

Objective: To determine the effect of physical exercise on Peak Expiratory Flow Rate (PEFR) and evaluate the percentage reduction in PEFR post-exercise among students.

Methodology: An experimental pre-test and post-test study was conducted on 200 participants aged 18–25 years. Baseline assessments of age, height, weight, BMI, and pre-exercise PEFR were recorded. Participants performed a standardized exercise protocol, followed by post-exercise PEFR measurements. The percentage fall in PEFR was calculated for each participant. Data were analyzed using paired sample t-tests and descriptive statistics.

Results: A total of 200 participants completed the assessment. Pre-exercise mean PEFR was 496.08 ± 76.87 L/min, which decreased significantly post-exercise to 435.62 ± 77.40 L/min ($p < 0.001$), representing a mean reduction of 60.47 L/min and a mean percentage fall of $12.28 \pm 6.43\%$. Furthermore, 40.0% ($n = 80$) of participants exhibited a PEFR fall $\geq 15\%$.

Conclusion: Physical exercise induces a statistically significant reduction in PEFR. Routine screening of pre- and post-exercise PEFR can help identify individuals with hyper-reactive airways and guide early prophylactic interventions.

Keywords: Peak Expiratory Flow Rate, PEFR, Exercise-Induced Bronchoconstriction, Respiratory Function, Physiotherapy Students

Introduction

Peak Expiratory Flow Rate (PEFR) is an important parameter used to measure maximum expiratory flow speed achieved during a forced expiration starting from full lung inflation. It reflects large airway caliber and respiratory muscle strength. Physical activity exerts major metabolic demands on the respiratory system, requiring increased ventilation. [1,2,3]

In healthy individuals, exercise normally leads to bronchodilation due to sympathetic nervous system stimulation. However, in individuals with airway hyper-responsiveness, high ventilation rates during

exercise cause heat and water loss from the respiratory mucosa, leading to transient airway narrowing known as exercise-induced bronchoconstriction (EIB). [1,3]

Monitoring PEFR response to physical exercise offers a practical, cost-effective screening tool for pulmonary function and airway hyper-responsiveness. While spirometry (FEV₁) remains the primary diagnostic standard, evaluating PEFR fall percentage provides immediate utility in field testing and academic setups. This study was undertaken to evaluate the changes in PEFR following physical exercise among young students. [1,2,3]

Aim of the Study

To evaluate the effect of exercise on Peak Expiratory Flow Rate (PEFR) and assess the magnitude of post-exercise PEFR reduction.

Objectives of the Study

1. To assess pre-exercise PEFR values among participants.
2. To assess post-exercise PEFR values among participants following a standardized exercise test.
3. To compare pre- and post-exercise PEFR values to evaluate the statistical significance of airway response.
4. To categorize participants based on the percentage fall in PEFR following exercise.

Hypothesis

Research Hypothesis (H₁)

There will be a statistically significant difference between pre-exercise and post-exercise PEFR values among participants.

Null Hypothesis (H₀)

There will be no statistically significant difference between pre-exercise and post-exercise PEFR values among participants.

Methodology

Study Design

Experimental pre-test and post-test study design was used.

Study Population

The study population consisted of physiotherapy students.

Sample Size

A total of 200 physiotherapy students participated in the study.

Age Group

Participants aged 18–25 years were included.

Sampling Method: Purposive Sampling.

Study Setting: The study was conducted at TMV's Indutai College of Physiotherapy, Pune.

Inclusion Criteria

- Young adults aged 18–25 years.
- Asymptomatic individuals capable of performing exercise testing.
- Normal Body Mass Index (BMI)

Exclusion Criteria

- Active respiratory tract infections or known chronic lung disease.
- Acute musculoskeletal injuries or cardiovascular contraindications to exercise.
- History of medication affecting airway tone (e.g., bronchodilators, beta-blockers) prior to testing.
- Non athletes.

Ethical Considerations

Ethical permission was obtained by TMV's Indutai Tilak College of Physiotherapy, Pune before commencement of the study. Participants were informed about the purpose and procedures of the study. Written informed consent was obtained from all participants before participation. Confidentiality of participant information was maintained throughout the study.

Outcome Measures

The following outcome measures will be assessed:

1. **Peak Expiratory Flow Rate (PEFR)** PEFR will be measured using a peak flow meter before and after the 1.5-mile walking test. Three trials will be performed at each assessment, and the highest value will be recorded in L/min.
2. **Percentage Fall in PEFR** The percentage fall in PEFR will be calculated by comparing the pre-exercise and post-exercise PEFR values.
Formula: Percentage fall in PEFR = $[(\text{Pre-exercise PEFR} - \text{Post-exercise PEFR}) / \text{Pre-exercise PEFR}] \times 100$
3. **Exercise-Induced Breathlessness** Exercise-induced breathlessness will be assessed following the 1.5-mile walking test as specified in the study protocol.
4. **1.5-Mile Walking Test** The 1.5-mile walking test will be used as the standardized exercise challenge to assess the participant's response to exercise.

PROCEDURE

1. The purpose and procedure of the study will be explained to the participants, and written informed consent will be obtained from each participant.
2. Baseline Peak Expiratory Flow Rate (PEFR) will be recorded using a peak flow meter. Three trials will be performed, and the highest recorded value will be considered as the baseline PEFR.
3. The participant will then be instructed to perform a 1.5-mile walking test as the standardized exercise protocol for assessing exercise-induced breathlessness.
4. Immediately following completion of the 1.5-mile test, post-exercise PEFR will be recorded using the same procedure. Three trials will be performed, and the highest value will be recorded as the post-exercise PEFR.
5. The percentage fall in PEFR will then be calculated by comparing the pre-exercise and post-exercise PEFR values.

6. A fall of $\geq 15\%$ in PEFR will be considered indicative of an exercise-induced airway response according to the study protocol.

$$\text{PEFR Fall (\%)} = [(\text{Pre PEFR} - \text{Post PEFR}) / \text{Pre PEFR}] \times 100$$

Statistical Analysis

Data were processed and analyzed using Microsoft Excel 2026 and statistical software. Descriptive statistics (mean, standard deviation, percentages) summarized participant demographics and physiological outcomes. A paired sample t-test was conducted to determine significant differences between pre- and post-exercise PEFR values. Statistical decision rules used a two-sided alpha level of $\alpha = 0.05$ ($p < 0.05$ considered statistically significant).

Results

All 200 participants completed the study with full data compliance.

Table 1: Age Distribution of Participants (n = 200)

Age (years)	Number of Subjects (n)	Percentage (%)
18	4	2.0%
19	7	3.5%
20	15	7.5%
21	28	14.0%
22	67	33.5%
23	38	19.0%
24	33	16.5%
25	8	4.0%

The mean age of participants was 22.16 ± 1.51 years.

Table 2: Demographic Characteristics by Gender

Characteristic	Category	n	Percentage (%)
Gender	Female	145	72.5%
Gender	Male	55	27.5%

Table 3: Participant Baseline Demographic Parameters (n = 200)

Variable	Mean $\pm$ SD	Median	Minimum	Maximum
Height (cm)	163.99 ± 9.05	163.00	150.00	180.00

Weight (kg)	57.52 ± 5.23	57.65	46.10	72.30
BMI (kg/m ²)	21.48 ± 2.06	21.50	18.50	28.60

Table 4: Comparison of Pre-Intervention and Post-Intervention PEFr Values

Variable	Pre-Exercise Mean ± SD	Post-Exercise Mean ± SD	Mean Diff	Paired t-value	p-value
PEFR (L/min)	496.08 ± 76.87	435.62 ± 77.40	60.47	26.253	< 0.001

The paired *t*-test demonstrated a highly statistically significant reduction in PEFr following exercise ($t(199) = 26.253, p < 0.001$).

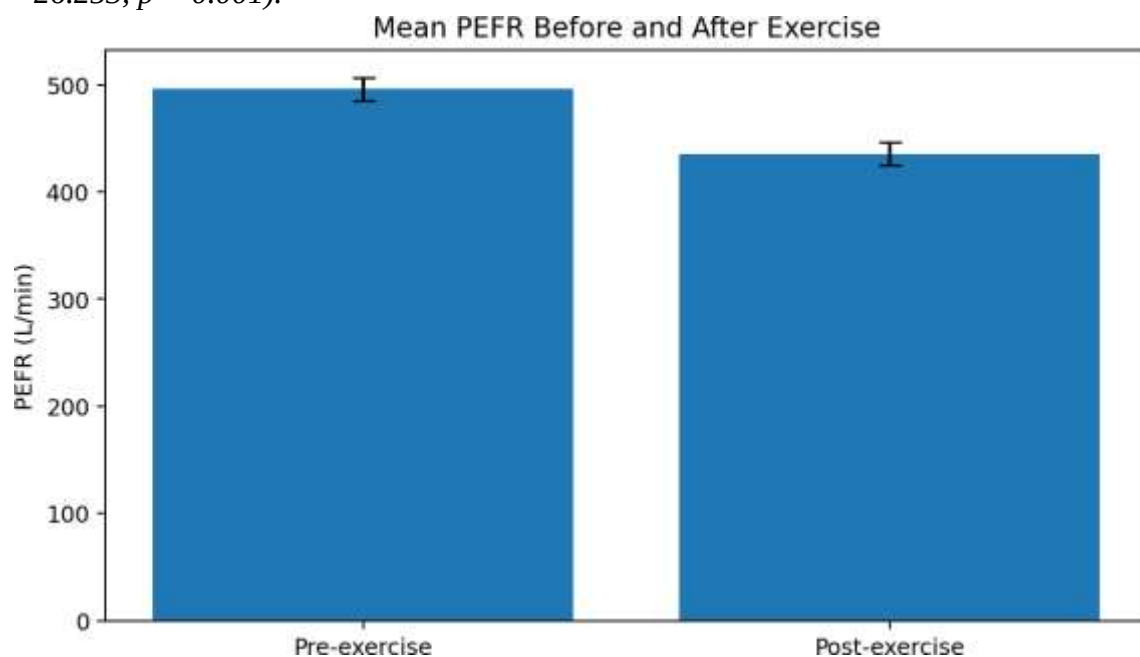
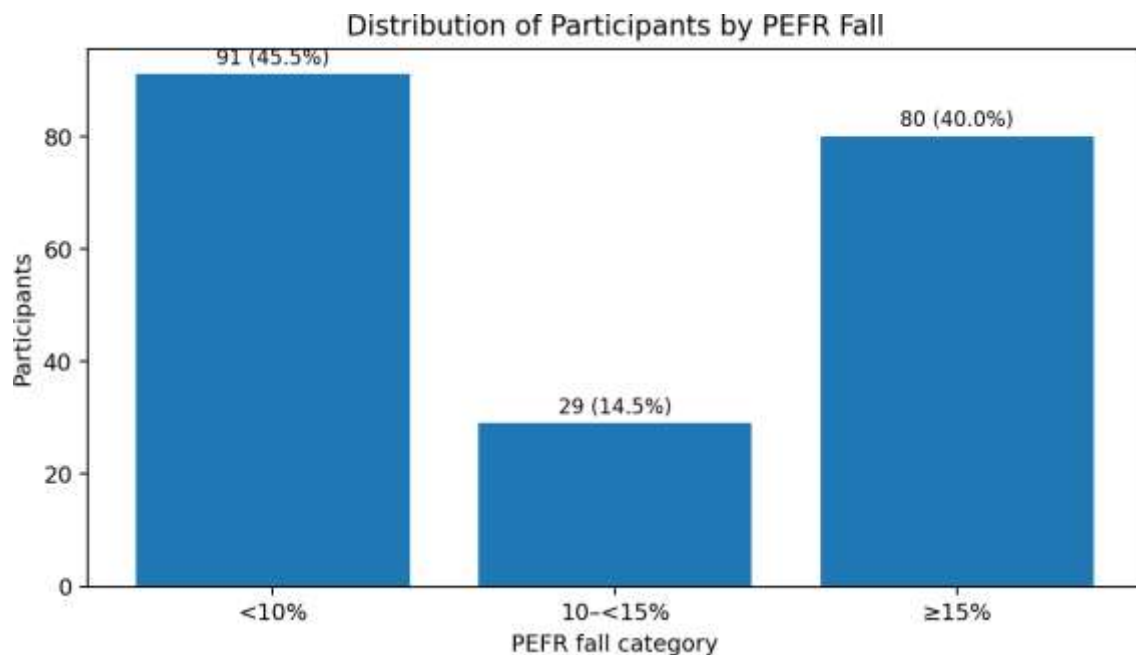


Table 5: Distribution of Participants by Percentage PEFr Fall Categories

PEFR Fall Category	Participants (n)	Percentage (%)
< 10%	91	45.5%
10% - < 15%	29	14.5%
≥ 15%	80	40.0%

A total of 80 participants (40.0%) demonstrated a PEFr fall ≥ 15%, while 109 participants (54.5%) had a fall ≥ 10%.



Discussion

The present study investigated the effect of exercise on Peak Expiratory Flow Rate (PEFR) among students. Findings revealed a significant drop in mean PEFR from 496.08 L/min to 435.62 L/min post-exercise ($p < 0.001$).

The physiological mechanism for post-exercise PEFR reduction is primarily linked to heat loss and hyperosmolar airway conditions caused by increased hyperpnea. Rapid breathing during exercise evaporates water from the airway mucosal surface, causing mucosal cooling and increased osmolarity. This triggers mast cell degranulation and the release of inflammatory mediators (such as histamine and leukotrienes), leading to smooth muscle contraction and airway narrowing. [1,3]

Our observations align with previous literature emphasizing exercise-induced airway changes. In this cohort, 40.0% of participants exhibited a PEFR fall of $\geq 15\%$, which is often considered clinically relevant for exercise-induced airway reactivity in screening protocols. [1,3]

Conclusion

The study concluded that physical exercise produces a statistically significant reduction in Peak Expiratory Flow Rate ($p < 0.001$). Screening pre- and post-exercise PEFR provides a valuable method for identifying airway reactivity and guiding appropriate exercise prescriptions.

Clinical Implications

Using PEFR as a screening outcome allows early detection of individuals prone to exercise-induced airway narrowing. Early identification enables physiotherapy clinicians to design tailored warm-up strategies, environmental adaptations, and respiratory training programs.

Limitations

- The study did not include a separate non-exercise control group.
- Spirometric evaluation (FEV_1) was not performed alongside peak flow measurements.

Recommendations

1. Conduct randomized controlled trials comparing dynamic lung volumes (FEV₁ vs. PEF_R).
2. Evaluate environmental conditions (humidity and temperature) during exercise testing.

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