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EFFECT OF BREATHING EXERCISES ON PEAK EXPIRATORY FLOW RATE IN COLLEGE STUDENTS: AN EXPERIMENTAL STUDY

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ABSTRACT

Objective: The purpose of this study was to determine the effect of breathing exercises on peak expiratory flow rate (PEFR) in college-going students, as PEFR is a simple and reliable measure of pulmonary function.
Methodology: An experimental study was conducted on 30 college-going students (18–25 years) with reduced PEFR and mild to moderate dyspnea. Baseline PEFR was measured using a peak flow meter, and dyspnea was assessed using the Modified MRC Dyspnea Scale. Participants performed diaphragmatic and thoracic expansion breathing exercises twice daily for 6 weeks, after which PEFR and MRC grades were reassessed and analyzed using SPSS.
Results: The findings demonstrated a statistically significant improvement in PEFR among college-going students after 6 weeks of breathing exercises ($P < 0.001$), indicating enhanced lung function and better expiratory capacity.
Conclusion: Breathing exercises are effective, simple, and non-invasive techniques that can significantly improve respiratory function in young adults. They may be recommended as part of routine health and fitness programs for college students, as they are easy to implement and show promise in improving pulmonary health in young adults.
Keywords: Breathing exercises, Peak Expiratory Flow Rate, Dyspnea, College students, Pulmonary function, Respiratory health

INTRODUCTION

Dyspnea is defined by the American Thoracic Society as a subjective experience of breathing discomfort that arises from complex interactions of physiological, psychological, social, and environmental factors, often requiring self-reporting for clinical evaluation[1]. It affects a significant proportion of both inpatient and outpatient populations and is one of the most common causes of emergency department visits.

The etiology of dyspnea is multifactorial and may include respiratory, cardiac, neuromuscular, psychogenic, and systemic conditions[2]. In the

context of college students, several lifestyle and environmental contributors can play a role. High academic stress, poor posture, physical inactivity, and substance use are among the common risk factors that compromise pulmonary function. Academic and examination stress often lead to unhealthy coping strategies, disturbed sleep, and emotional strain, all of which can negatively affect overall health and predispose young adults to breathing difficulties[3].

Substance use, particularly heavy alcohol consumption, further exacerbates the problem by impairing lung immunity, increasing the risk of pulmonary infections, and contributing to breathlessness[4]. Additionally, exposure to environmental pollutants such as particulate matter and nitrogen oxides has been associated with increased respiratory symptoms, including cough, wheezing, and shortness of breath[5]. Postural deviations, such as prolonged slouched sitting commonly observed among students, reduce lung capacity and peak expiratory flow rate (PEFR), thereby heightening the likelihood of dyspnea[6].

From a physiological perspective, dyspnea develops when the force required by respiratory muscles exceeds their capacity, especially when inspiratory resistance is elevated or respiratory muscle strength is reduced[7]. A mismatch between the central respiratory motor activity and the mechanical response of the respiratory system contributes to the perception of breathing discomfort. The length-tension appropriateness paradigm further explains that this sensation arises not only from respiratory muscle afferents but also from receptors throughout the respiratory system[8].

PEFR serves as a simple, quick, and non-invasive measure of bronchial airflow obstruction. Reduced PEFR in otherwise healthy individuals with mild dyspnea may reflect poor perception of respiratory effort and compromised pulmonary function[9]. Normal PEFR values are typically 450–550 L/min in adult males and 320–470 L/min in adult females[10]. Measuring PEFR involves standardized procedures, including maximal exhalation through a peak flow meter, and is an important tool in both clinical and research settings[11].

Breathing exercises provide a safe and effective means to enhance pulmonary function. Diaphragmatic breathing improves diaphragmatic efficiency, thoracic expansion promotes lung inflation and collateral ventilation[12], and pursed-lip breathing helps to maintain airway patency while enhancing gas exchange[13]. Collectively, these exercises strengthen respiratory muscles, improve ventilation, and reduce the sensation of breathlessness.

SIGNIFICANCE

To addresses the increasing prevalence of stress-induced dyspnea among college students.

To evaluates a non-invasive, safe, and cost-effective intervention for improving pulmonary function.

To helps enhance Peak Expiratory Flow Rate (PEFR) and overall respiratory efficiency.

To highlights the impact of lifestyle, posture, and stress on respiratory health.

Contributes to preventive strategies aimed at reducing respiratory discomfort and promoting a better quality of life in young adults.

OBJECTIVES

To develop awareness campaigns about respiratory health and educate students on techniques for managing stress and anxiety to reduce dyspnea.

To encourage healthy lifestyles through regular exercise and smoking cessation.

To teach breathing exercises to increase lung capacity.

To promote postural awareness among students.

MATERIALS AND METHODS

The study was conducted at NRI College of Physiotherapy. The sample population consisted of college-going students with complaints of shortness of breath, cough, chest pain and wheeze. A total of 30 subjects were selected, and the study duration was 12 months .The materials used in the study included a peak flow meter, pen and data collection sheets. The inclusion criteria included participants aged between 18 and 25 years, both males and females, with a PEFR of less than 300 L/min for females and less than 350 L/min for males, and subjects presenting with mild to moderate dyspnea. The exclusion criteria included lack of consent, the

presence of any acute illness, and acute exacerbations at the time of inclusion in the study.

Obtained at two occasions ,pre intervention and post intervention measurements

- Peak Expiratory Flow Rate (PEFR)
- Medical Research Council (MRC) Dyspnea Scale

All subjects who were screened and found positive for dyspnea were included in the study group.

A twelve-month treatment protocol was established, and pre-intervention measurements were obtained for all participants.

The intervention comprised three breathing exercises—

- Diaphragmatic breathing
- Thoracic expansion exercises targeting the apical and middle lobes,
- Pursed-lip breathing

Each performed for 5 repetitions, twice daily, with every session lasting 10 minutes.

Upon completion of the twelve-month intervention, outcome measures were obtained for all subjects, and data were analyzed by comparing pre- and post-intervention values.

RESULTS

Age	Mean	Standard deviation	
18-25 years	20.0	1.45	
Frequency of Gender	Counts	% of Total	Cumulative %
Female	28	93.3%	93.3%
Male	2	6.7%	100.0%

Demographic Data of the 30 subjects

Age Distribution

- The participants were in the age group of 18–25 years.
- The mean age of the participants was 20.0 years.
- The standard deviation was 1.45, which shows a small variation in age among participants.

Gender Distribution

- Out of the total participants, 28 were females, which accounts for 93.3% of the sample.
- Only 2 participants were males, making up 6.7% of the sample.
- The cumulative percentage reached 93.3% with females and 100% after including males, covering the entire study population.

Table 2

Presenting symptoms

Shortness of Breath	Counts	% Total	Cumulative %
Present	30	100.0%	100.0%
Absent	0	0 %	0%
Cough	Counts	% Total	Cumulative %
Present	10	33.3%	100.0%
Absent	20	66.7%	66.7%
Chest Pain	Counts	% Total	Cumulative %
Present	12	40.0%	100.0%
Absent	18	60.0%	60.0%
Wheeze	Counts	% Total	Cumulative %
Present	12	40.0%	100.0%
Absent	18	60.0%	60.0%

Presenting Symptoms of the 30 subjects

- Shortness of breath: Present in 30 (100.0%), absent in 0 (0%).
- Cough: Present in 10 (33.3%),absent in 20 (66.7%)
- Chest pain: Present in 12 (40.0%), absent in 18 (60.0%)
- Wheeze: Present in 12 (40.0%), absent in 18 (60.0%).

Table 3

Outcome measures

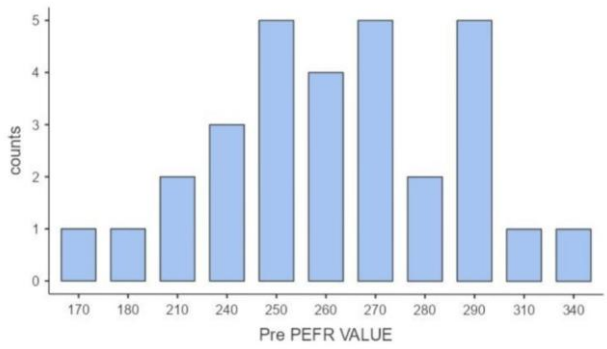
	Mean	Median	Standard deviation	Minimum	Maximum	P Value
Pre PEFR	**260**	**260**	**35.2**	**170**	**340**	**<0.001**
Post PEFR	**332**	**330**	**45.3**	**240**	**480**	**<0.001**

Measurement of Pre and Post PEFR of the 30 subjects

- The pre-PEFR showed a mean of 260, a median of 260, a standard deviation of 35.2, with values ranging from 170 to 340 ($p < 0.001$).
- The post-PEFR showed a mean of 332, a median of 330, a standard deviation of 45.3, with values ranging from 240 to 480 ($p < 0.001$).

Figure 1

Pre PEFR



Interpretation of Pre PEFR of the 30 subjects

- Most frequent PEFR values lie between 250 and 270, where the count is highest (around 5 individuals each).
- A moderate number of individuals have PEFR values between 240 and 260, and around 290.
- Fewer individuals have values at the extreme ends (e.g., 170, 180, 310, 340).
- The distribution shows a rough bell shape, suggesting a normal-like distribution, though it is slightly skewed to the right due to a small number of higher PEFR values (e.g., 310 and 340).

	Grade	Counts	% Total	Cumulative %
Pre MRC	3	2	6.7%	6.7%
	2	7	23.3%	30.0%
	1	21	70.0%	100.0%
	Grade	**Counts**	**% Total**	**Cumulative %**
Post MRC	1	6	20.0%	20.0%
	0	24	80.0%	100.0%

Grading of Pre and Post MRC of the 30 subjects

Before the intervention, the MRC grades were distributed as follows: Grade 3 in 2 participants (6.7%), Grade 2 in 7 participants (23.3%), and Grade 1 in 21 participants (70.0%).

After the intervention, the MRC grades improved, with Grade 1 in 6 participants (20.0%) and Grade 0 in 24 participants (80.0).

DISCUSSION

The findings of the present study indicate a statistically significant improvement in Peak Expiratory Flow Rate (PEFR) following a structured breathing exercise program in college-going students. This is consistent with the outcomes reported by Pooja Bharat Mistry et al., who evaluated the effect of Buteyko breathing on PEFR in carpenters. Their study demonstrated that controlled breathing techniques could reduce airway resistance and enhance airflow, particularly in populations exposed to occupational respiratory irritants. Although their target population (carpenters) differed from that of the present study (college students), both studies included the same number of subjects 30. The mean age group in their study was 35–45 years, whereas in our study it was 18–25 years. They employed Buteyko breathing exercises, while we used deep breathing exercises. Their intervention lasted for 4 weeks with two sessions per week, whereas our intervention lasted for 6 weeks with sessions conducted twice daily. Despite these differences, both groups demonstrated reduced baseline PEFR values, highlighting the effectiveness of respiratory retraining techniques across different environmental contexts[14].

Similarly, the study by prem et al. on the effect of diaphragmatic breathing on health supported the therapeutic role of deep breathing in improving pulmonary efficiency. Their research demonstrated that regular diaphragmatic breathing resulted in enhanced oxygenation, reduced dyspnea, and improved cardiorespiratory fitness over time. In our study, diaphragmatic breathing was one of the core components of the intervention protocol. The PEFR improvement observed in our subjects corroborates the physiological benefits noted by Prem et al., specifically regarding increased alveolar ventilation and better respiratory muscle engagement[15].

The findings of the present study on college-going students can be meaningfully compared with those of a recent investigation, "Effectiveness of Segmental Breathing and Expansion Thorax Exercise in Young to Middle-Aged Post-Covid Survivors," conducted by Nova Relida Samosir et.al. In the post-COVID population, segmental breathing and thoracic expansion exercises were administered over 12 sessions, resulting in significant improvements in Peak Expiratory Flow Rate (PEFR) and thoracic expansion, indicating that these exercises are effective in restoring lung function compromised by illness. In contrast, the current study targeted a healthy, young population of college students who practiced structured breathing exercises and demonstrated not only a statistically significant increase in PEFR but also reported substantial relief from dyspnea. This highlights that while post-COVID patients benefited primarily in terms of regaining lost lung function, college students experienced both objective and subjective benefits, including symptom reduction and improved breathing comfort. Thus, both studies reinforce the effectiveness of breathing exercises, but the present study adds an important dimension by showing their preventive and health-promoting value in otherwise healthy individuals[16].

In the study "The Effects of Positioning and Pursed-Lip Breathing Exercise on Dyspnea and Anxiety Status in Patients with Chronic Obstructive Pulmonary Disease" by Salwa A. Mohamed, the use of breathing techniques and the forward-leaning position in COPD patients was found to improve physiological outcomes, reduce dyspnea, and alleviate anxiety after implementation of the program, making it a valuable component of clinical management. In comparison, pursed-lip breathing and positioning in college-going students help to reduce dyspnea, reflecting the role of such exercises in promoting respiratory efficiency and comfort even in younger, generally healthy individuals. While the intervention in COPD patients targets both physiological and psychological outcomes in a chronic disease population, its application in students emphasizes the preventive and supportive benefits for respiratory health[17].

LIMITATIONS OF THE STUDY: The study had certain limitations, including a small sample size of only 30 participants, a marked gender imbalance, and a relatively short study duration. In addition, the absence of long-term follow-up limited the ability to assess sustained effects. Furthermore, the study was restricted to a narrow age group of 18 to 25 years, which reduces the generalizability of the findings to other age groups.

FUTURE RECOMMENDATIONS: Future research should aim to recruit a larger and more diverse sample population to enhance the validity and generalizability of the findings. Employing longitudinal study designs with follow-up assessments would allow researchers to evaluate the long-term effectiveness and sustainability of the intervention. Furthermore, conducting comparative studies involving other respiratory training techniques could help determine relative efficacy and identify the most beneficial approaches. In addition, applying the intervention to populations with chronic respiratory conditions would provide valuable insights into its broader clinical applicability and potential role in therapeutic management.

CONCLUSION

In summary, the present study highlights the effectiveness of structured breathing exercises in improving respiratory function among young adults. Breathing exercises, including diaphragmatic breathing, thoracic expansion exercises, and pursed-lip breathing, were found to significantly improve Peak Expiratory Flow Rate (PEFR) and reduce dyspnea symptoms among college-going students. These techniques are simple, cost-effective, and easy to incorporate into daily routines, making them a practical approach for enhancing pulmonary function in young adults. The findings suggest that such exercises hold considerable potential in promoting respiratory health, preventing pulmonary complications, and contributing to overall well-being.

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