

Efficacy of TheraBand Resisted Chest Expansion Exercises on Pulmonary Function in Male Collegiate Smokers

Sukhmandeep Singh Thind¹; Manu Vishist²; Ravneet Kaur³

¹Postgraduate Student, Department of Physiotherapy, Khalsa College, Amritsar, Punjab, India

²Head of Department, Department of Physiotherapy, Khalsa College, Amritsar, Punjab, India

³Postgraduate Student, Department of Physiotherapy, Khalsa College, Amritsar, Punjab, India

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Abstract:

➤ *Background:*

Smoking adversely affects pulmonary function and may contribute to respiratory impairment even among young individuals. Respiratory exercises may help improve pulmonary function; however, evidence regarding the effectiveness of TheraBand-resisted chest expansion exercises in young smokers is limited.

➤ *Objective:*

To determine the efficacy of TheraBand-resisted chest expansion exercises on pulmonary function in male collegiate smokers and to compare their effects with diaphragmatic breathing exercises.

➤ *Methods:*

A randomized controlled trial was conducted among 64 male collegiate smokers aged 20–25 years. Participants were randomly allocated into two groups of 32 each. Group A received TheraBand-resisted chest expansion exercises, while Group B received diaphragmatic breathing exercises. Both interventions were performed 4 days per week for 4 weeks. Pulmonary function was assessed using spirometry, including forced vital capacity (FVC), forced expiratory volume in one second (FEV₁) and FEV₁/FVC ratio. Data were analysed using paired and unpaired t-tests.

➤ *Results:*

Both groups showed significant improvement in pulmonary function following the intervention. Between-group analysis demonstrated significantly greater improvement in FVC and FEV₁ in the TheraBand group compared with the diaphragmatic breathing group ($p < 0.05$). However, the between-group difference in FEV₁/FVC was not statistically significant ($p > 0.05$).

➤ *Conclusion:*

Four weeks of TheraBand-resisted chest expansion exercises produced greater improvements in FVC and FEV₁ compared with diaphragmatic breathing exercises among male collegiate smokers. TheraBand-resisted chest expansion exercises may therefore be considered a beneficial physiotherapeutic intervention for improving selected pulmonary function parameters in young smokers.

Keywords: TheraBand; Chest Expansion Exercises; Pulmonary Function; Smoking; Collegiate Smokers; Diaphragmatic Breathing; Spirometry.

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I. INTRODUCTION

Smoking is defined as the inhalation of tobacco smoke produced from burning cigarettes, cigars, or pipes. It may occur occasionally as a habit or may develop into a regular practice involving physical dependence on nicotine, the main addictive component of tobacco products.^[1]

As early as 1526, the Spanish historian Fernandez de Oviedo recognized smoking as a harmful practice. However, despite centuries of use, the serious health dangers of smoking were widely acknowledged only in the late 20th century, especially in developed countries. This delay is surprising given the massive death toll caused by smoking.^[2]

According to WHO, the total deaths from cigarette smoking are expected to surpass those caused by AIDS, cancer or traffic accidents.^[3] The prevalence of smoking is more than ten times greater than that of non-smokers; and about one-fourth of heavy smokers eventually develop COPD.^[4] Under normal conditions, oxygen is transported through the bloodstream to the body, but in smokers, carbon monoxide is transported instead of oxygen, resulting in respiratory problems such as breathlessness and cough in the acute phase.^[5] Smoking also causes mucus-secreting cells to increase in size and number leading to thickened mucus and membranes that compromise the body's natural defense against inflammation.^[6]

Smoking is a major risk factor for cardiovascular diseases particularly atherosclerosis and coronary heart disease (CHD), which is the leading cause of death in most developed countries. The two key mechanisms involved in CHD are atherosclerosis and thrombosis. Cigarette smoking is the most important cause of cancer mortality in the Western world and is responsible for about 30% of all cancer-related deaths. Overall cancer death rates are approximately twice as high in smokers compared with nonsmokers and increase up to fourfold in heavy smokers.^[2]

Research has demonstrated that smoking reduces pulmonary function parameters such as FVC, FEV1 and forced expiratory flow; which may eventually result in airway obstruction and small airway disease. The decrease in FVC among smokers has been attributed to weakened respiratory muscle strength. Young smokers; therefore are at heightened risk of developing respiratory diseases later in life. Consequently, respiratory training in addition to medical and psychological interventions, should be an essential component of antismoking programs.^[7]

Proper breathing exercises can induce hypertrophy of respiratory muscles, thereby improving their strength and enhancing pulmonary function.^[8] Respiratory function can be evaluated using several techniques including Spirometry. it is a standard physiological test that records inhaled and exhaled air volume as a function of time; serving as a valuable screening tool for general respiratory health. Lung volume measurements help determine respiratory function normality.^[9] Various therapeutic interventions have been employed to improve chest function, including inspiratory

muscle training, limb-based muscle mobilization exercise programs and patient education. More recently, the use of an elastic chest band has been proposed as an effective adjunct to facilitate diaphragmatic function and improve breathing patterns. The diaphragm plays a critical role in rib cage expansion, and the external load applied by a chest band may be counterbalanced by enhanced diaphragmatic efficiency. The compressive force exerted by the chest band creates consistent resistance to thoracic expansion, thereby facilitating both strength and endurance training of the respiratory muscles.^[10]

Previous studies have similarly reported a strong association between respiratory activity and postural control. Elastic bands are considered particularly suitable for elderly populations, as they are safe, simple to use and capable of producing strength gains comparable to those achieved with conventional resistance training equipment. In addition, elastic band exercises promote whole-body muscle activation and are portable and cost-effective.^[11] Therefore Thera-band resisted chest expansion exercises specifically target the enhancement of pulmonary function. Thus, the present study was undertaken to determine the effect of TheraBand-resisted chest expansion exercises on pulmonary functions among male collegiate smokers.

II. MATERIALS AND METHODS

➤ Study Design

The study was a randomized controlled trial in nature.

➤ Study Setting

This study was carried out at the Physiotherapy OPD, Khalsa College, Amritsar.

➤ Ethical Consideration

The current study was approved by Institutional Ethics Committee (IEC), Khalsa College, Amritsar (No.IEC/KCA/PT/2025/20). An information form and consent form was given to the target smokers. This was given to them to decide if they are willing to participate and were informed about the purpose of the study. They were allowed to ask questions regarding the same. The privacy and confidentiality of the subject was maintained throughout the study. The relative design, conduct and data analysis of this research followed the recommendations of the CONSORT guidelines (Fig. 1)

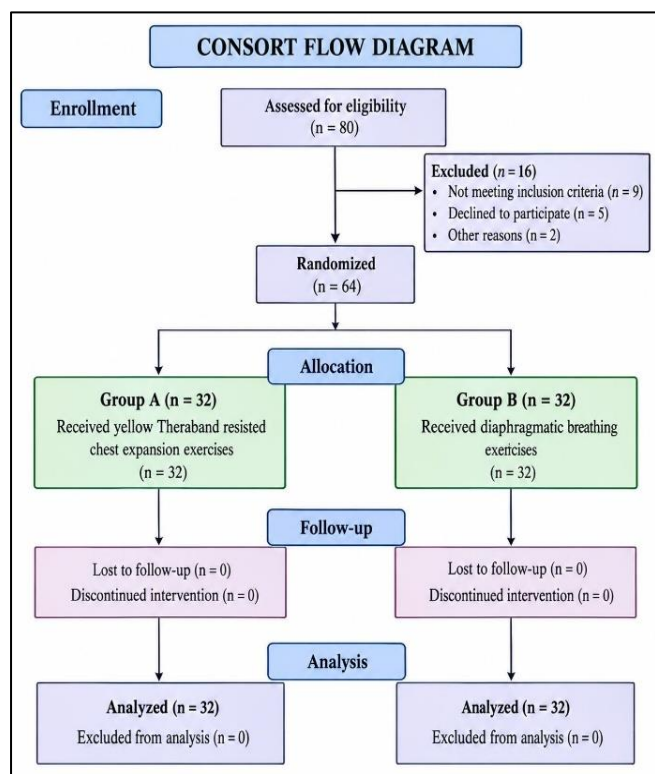


Fig 1 Consort Flow Diagram

➤ Inclusion Criteria

Participants were eligible for inclusion if they were male collegiate smokers aged 20–25 years, current smokers with a history of smoking for ≥ 2 pack-years and clinically healthy individuals without diagnosed chronic respiratory, cardiac or neurological diseases.

➤ Exclusion Criteria

Participants with COPD, asthma, restrictive lung disease, recent respiratory infection, chest wall or spinal deformities, congenital heart defects, neurological disorders limiting exercise, previous respiratory muscle training, or musculoskeletal conditions affecting upper-limb movements were excluded.

➤ Sample Size

The sample size for the study was calculated using G*Power version 3.1.9.7. An a priori power analysis was performed using a one-tailed independent-samples t-test for the difference between two independent means. The calculation was based on an anticipated effect size (Cohen's d) of 0.63, a significance level (α) of 0.05, and a statistical power of 0.80 (80%), with an allocation ratio of 1:1 between the two groups. The analysis indicated a required sample size of 64 participants, with 32 participants allocated to the intervention group and 32 participants allocated to the control group. The calculated actual power for the proposed sample size was 0.8016395 (approximately 80.16%). Thus, a total of 64 male collegiate smokers aged 20–25 years were included in the study.

➤ Procedure

A total of 64 participants fulfilling the selection criteria were included in the study. Written informed consent was

obtained from all participants after explaining the study procedure and its benefits. Baseline assessment was performed before commencement of the intervention. Participants were then randomly divided into two groups:

Group A (n=32) received TheraBand-resisted chest expansion exercises, while Group B (n=32) performed diaphragmatic breathing exercises. Pulmonary function was assessed using spirometry, including forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and FEV1/FVC ratio. Each spirometric measurement was performed three times, and the highest value was recorded for analysis.

Both groups underwent their respective intervention 4 days per week for 4 weeks. Following completion of the 4-week intervention period, the participants underwent post-intervention assessment using the same outcome measures, and the obtained data were recorded for statistical analysis.

➤ Intervention:

- Study Group (A): subjects who were receiving Thera-band resisted chest expansion exercises technique.
- Study Group (B): subjects who were receiving diaphragmatic breathing technique.

➤ Instructions for Thera-band Resisted Chest Expansion exercises:

- Step 1: Therapist demonstrates the exercise once.
 - Step 2: Participant sits upright on a chair without armrest or backrest, feet flat on the ground, knees not widened.
 - Step 3: Warm-up – participant breathes in and out normally for 3–4 breaths.
 - Step 4: Participant performs upper extremity flexion, abduction and external rotation with inspiration and extension, adduction, and internal rotation with expiration without Thera-band.
 - Step 5: Repeat the same movement pattern using a Thera-band, maintaining coordination with breathing.
 - Step 6: During the first 2 weeks perform these movements using yellow Thera-band; then progress to red Thera-band in next 2 weeks.
 - Step 7: Each movement cycle (inspiration with flexion/abduction/external rotation + expiration with extension/adduction/internal rotation) is counted as one repetition.
- ✓ Repetitions & Sets: Perform 10 repetitions in one set, 3 sets per session.
- ✓ Rest Interval: 1–2 minutes between sets.
- ✓ Frequency & Duration: 4 days per week, for 4 weeks.^[12]

➤ Instructions for Diaphragmatic Breathing:

- Step 1: Participant sits comfortably in upright position with back supported, feet flat on floor.
- Step 2: Place one hand on the chest and the other just below the ribcage.

- Step 3: Inhale slowly through the nose, allowing the stomach to expand outward against the hand, while keeping the chest as still as possible.
 - Step 4: Tighten abdominal muscles and exhale slowly through pursed lips.
 - Step 5: Continue focusing on abdominal movement for each breath cycle.^[13]
- ✓ Repetitions & Sets: Perform 10 breaths in one set, 3 sets per session.
- ✓ Rest Interval: 1–2 minutes between sets.
- ✓ Frequency & Duration: 4 days per week, for 4 weeks.

Following the 4-week intervention period, post-intervention assessments were conducted, and the data was recorded for analysis of the outcomes.

➤ Outcome Measures

• Pulmonary Function Testing:

Pulmonary function refers to the efficiency and functional capacity of the respiratory system to inhale, exhale and exchange gases effectively. Pulmonary function is assessed using a spirometer. Participants sits upright in a chair with a backrest, facing forward and measurements are taken one minute after being seated. The procedure involves three normal breaths, followed by a maximal inhalation without regard to time and then a rapid, forceful exhalation until no more air could be expelled. Immediately afterward, participants are instructed to inhale again as quickly and forcefully as possible. At the end of each trial, the evaluator

presses the stop button, after which participants take rest. The parameters recorded included forced vital capacity (FVC), forced expiratory volume in one second (FEV₁), the ratio of FEV₁ to FVC (FEV₁/FVC). These parameters indicate lung volume, airway patency and expiratory efficiency in male collegiate smokers Each measurement is repeated three times, and the highest value was taken for analysis. Air volume is expressed in liters (L).^[14]

➤ Statistical Analysis

The data were analysed using the Statistical Package for the Social Sciences (SPSS) version 24. Statistical analysis was performed using paired and unpaired t-tests. The paired t-test was used for within-group comparisons, while the unpaired t-test was used for between-group comparisons.

III. RESULTS

Between-group analysis showed a statistically significant improvement in pulmonary function following the intervention. The TheraBand group demonstrated greater improvement in FVC compared with the diaphragmatic breathing group (4.272 ± 0.499 L vs. 3.999 ± 0.585 L; $p = 0.049$) and in FEV₁ (3.648 ± 0.385 L vs. 3.306 ± 0.520 L; $p = 0.004$). However, the between-group difference in FEV₁/FVC ratio was not statistically significant (85.704% vs. 82.980%; $p = 0.142$). Baseline values for FVC, FEV₁, and FEV₁/FVC were comparable between the two groups ($p > 0.05$). Overall, the TheraBand resisted chest expansion exercise produced greater improvements in FVC and FEV₁ than diaphragmatic breathing.

Table 1 Unpaired T-test for Comparison at Pre and Post Score Measurements of FVC (L) Between Group A and Group B

Unpaired t-test	Comparison			
	FVC (L)			
	Pre Score		Post Score	
	Group-A	Group-B	Group-A	Group-B
Mean	3.868	3.942	4.272	3.999
S.D.	0.5	0.594	0.499	0.585
N	32	32	32	32
M.D.	0.073		0.273	
df	62			
Unpaired t-test	0.535		2.012	
Tab. value at 0.05	1.999			
P value	0.595		.049*	
Result	Non-Significant		Significant	

Table 2 Unpaired T-test for Comparison at Pre and Post Score Measurements of FEV1 (L) Between Group A and Group B

Unpaired t-test	Comparison			
	FEV1 (L)			
	Pre Score		Post Score	
	Group-A	Group-B	Group-A	Group-B
Mean	3.138	3.217	3.648	3.306
S.D.	0.381	0.519	0.385	0.52
N	32	32	32	32
M.D.	0.079		0.343	
df	62			
Unpaired t-test	0.692		3	
Tab. value at 0.05	1.999			
P value	0.492		.004**	
Result	Non-Significant		Significant	

Table 3 Unpaired T-test for Comparison at Pre and Post Score Measurements of FEV1/FVC (%) Between Group A and Group B

Unpaired t-test	Comparison			
	FEV1/FVC (%)			
	Pre Score		Post Score	
	Group-A	Group-B	Group-A	Group-B
Mean	81.476	81.914	85.704	82.98
S.D.	6.486	8.413	5.815	8.573
N	32	32	32	32
M.D.	0.438		2.724	
df	62			
Unpaired t-test	0.233		1.488	
Tab. value at 0.05	1.999			
P value	0.816		0.142	
Result	Non-Significant		Non-Significant	

IV. DISCUSSION

The present study aimed to evaluate the effects of Thera-band resisted chest expansion exercises and diaphragmatic breathing technique on pulmonary functions among male collegiate smokers, given the limited evidence in literature. In the present study, both groups showed statistically significant improvement in pulmonary function parameters (FVC, FEV1, FEV1/FVC) ($p < 0.05$, within-group). However, the Thera-band resisted chest expansion exercise group demonstrated significantly greater improvement in FVC and FEV1 compared to the diaphragmatic breathing group ($p < 0.05$, between-group), whereas the between-group difference in FEV1/FVC was not statistically significant ($p > 0.05$). The improvement in pulmonary function in the Thera-band group can be attributed

to enhanced thoracic expansion and increased activation of both primary and accessory respiratory muscles. The resistance provided by Thera-band increases the workload on respiratory muscles, thereby improving their strength, endurance, and coordination. This results in improved inspiratory capacity, better expiratory flow rates and enhanced alveolar ventilation.

These findings are consistent with Bhatnagar and Sharma, who reported significant improvement in pulmonary function and chest expansion following chest PNF and breathing exercises in smokers^[3]. Zahra et al. also demonstrated that breathing exercises significantly improve lung volumes and capacities among smokers.^[5] Furthermore, studies involving resistance-based respiratory training, such as elastic band exercises, have shown enhanced pulmonary

outcomes due to increased muscular engagement and thoracic mobility.^[11,14] Although a few studies have reported beneficial effects with alternative breathing techniques, the present study demonstrated significant improvements in pulmonary function following TheraBand-resisted chest expansion exercises. These findings suggest that resisted chest expansion exercises may be a simple and effective physiotherapeutic intervention for improving pulmonary function in male collegiate smokers.

V. LIMITATIONS OF THE STUDY

The present study had certain limitations, including the inclusion of only male collegiate smokers, which limits the generalizability of the findings to females and other age groups. The intervention period was limited to four weeks, restricting the assessment of long-term effects. Smoking exposure was assessed using pack-years without separately accounting for variations in daily smoking intensity, while other lifestyle factors such as physical activity, diet, and smoking-related habits were not controlled. Additionally, the study was conducted at a single centre. Future studies should include larger and more diverse samples comprising both sexes and different age groups, employ longer intervention and follow-up periods, assess smoking exposure in greater detail, and monitor relevant lifestyle factors. Multicentre studies are also recommended to strengthen the generalizability and evidence regarding the effects of TheraBand resisted chest expansion exercises on pulmonary function.

VI. CONCLUSION

The present study concluded that four weeks of TheraBand resisted chest expansion exercises were effective in improving pulmonary function among male collegiate smokers. Compared with diaphragmatic breathing exercises, the TheraBand group demonstrated significantly greater improvements in FVC and FEV₁, whereas the between-group difference in FEV₁/FVC was not statistically significant. Thus, TheraBand resisted chest expansion exercises may be considered a beneficial physiotherapeutic intervention for improving selected pulmonary function parameters in male collegiate smokers.

REFERENCES

- [1]. Leone A, Landini L, Leone A. What is tobacco smoke? Sociocultural dimensions of the association with cardiovascular risk. *Current pharmaceutical design*. 2010 Aug 1;16(23):2510-7.
- [2]. Skurnik Y, Shoenfeld Y. Health effects of cigarette smoking. *Clinics in Dermatology*. 1998;16(5):545-556. doi: 10.1016/S0738-081X(98)00037-6
- [3]. Effectiveness of Chest PNF and breathing Exercises on Pulmonary Function and Chest Expansion in Male Smokers. *IJPOT* [Internet]. 2021 Dec. 1 [cited 2026 Sep. 19];16(1):159-68. Available from: <https://medicopublication.com/index.php/ijpot/article/view/17790>
- [4]. Chen YC, Cao JM, Zhou HT, Guo X, Wang Y. The effect of loaded deep inhale training on mild and moderate COPD smokers. *International Journal of Clinical And Experimental Medicine*. 2014 Oct 15;7(10):3583.
- [5]. 1.Zahra I, Liaqat M, Qadeer U. Effects Effects of Breathing Exercises on Lung Volumes and Capacities Among Smokers. *IIMJ* [Internet]. 2020 Dec. 30 [cited 2026 Sep. 19];2(1):35-9. Available from: <https://journal2.unusa.ac.id/index.php/IIMJ/article/view/1829>
- [6]. K V. Efficacy of Balloon Blowing Exercise on Peak Expiratory Flow Rate in Young Adult Smokers. *Journal of Lifestyle Medicine*. 2020; doi:10.15280/JLM.2020.10.2.116
- [7]. Seo K, Park SH, Park K. Effects of diaphragm respiration exercise on pulmonary function of male smokers in their twenties. *Journal of physical therapy science*. 2015;27(7):2313-5.
- [8]. Bostanci Ö, Mayda H, Yılmaz C, Kabadayı M, Yılmaz AK, Özdal M. Inspiratory muscle training improves pulmonary functions and respiratory muscle strength in healthy male smokers. *Respiratory physiology & neurobiology*. 2019 Jun 1;264:28-32.
- [9]. Tantisuwat A, Thaveeratitham P. Effects of smoking on chest expansion, lung function, and respiratory muscle strength of youths. *Journal of physical therapy science*. 2014;26(2):167-70.
- [10]. Kim JH, Park HK, Jeon SY, Oh DW, Park HJ, Park WJ. Initial effect of an elastic chest band during inspiratory exercise on chest function improvement in people with limited rib mobility: a randomized controlled pilot trial. *Physiotherapy research international*. 2012 Dec;17(4):208-13.
- [11]. Kim K, Han JW, Kim YM. Effects of elastic band resistance exercises with breathing techniques on pulmonary function in female seniors. *Journal of exercise rehabilitation*. 2019 Jun 30;15(3):419.
- [12]. Shin SO, Kim NS. Accessory respiratory muscle activation during chest expansion exercise using elastic bands in children with cerebral palsy. *Korean Society of Physical Medicine*. 2016 Aug 31;11(3):119-24.
- [13]. Naz T, Aslam B, Abid F, Sabir S. Effects of deep breathing exercise on pulmonary function, perceived stress and physical fitness among healthy smokers: randomized clinical trail. *The Rehabilitation Journal*. 2025 Apr 26;9(02):03-11.
- [14]. Kim K, Han JW, Kim YM. Effects of elastic band resistance exercises with breathing techniques on pulmonary function in female seniors. *Journal of exercise rehabilitation*. 2019 Jun 30;15(3):419.