



IMPACT OF SMOKING ON LUNG FUNCTION TEST AND CHEST EXPANSION AMONG YOUNG ADULTS - A SYSTEMIC REVIEW

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Abstract

Background: Smoking is a major preventable cause of respiratory dysfunction globally. Young adults are increasingly engaging in smoking habits, often unaware of the early impact on lung health.

Objective: To assess and compare the lung function and chest expansion between young adult male smokers and non-smokers.

Methods: A cross-sectional comparative study was conducted among 100 young adult males (50 smokers and 50 non-smokers) aged 15–24 years. Lung function parameters including Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 second (FEV1), FEV1/FVC%, and Peak Expiratory Flow Rate (PEFR) were measured using a spirometer. Chest expansion was measured at the level of the fourth intercostal space using a measuring tape. Data were analysed using independent t-tests.

Results: Smokers showed significantly lower values in FVC (3.12 ± 0.56 vs. 4.05 ± 0.47 L), FEV1 (2.67 ± 0.49 vs. 3.85 ± 0.51 L), FEV1/FVC% (85.4 ± 4.6 vs. 95.1 ± 3.7), PEFR (370.2 ± 52.4 vs. 480.6 ± 60.3 L/min), and chest expansion (3.1 ± 0.7 vs. 4.3 ± 0.8 cm) compared to non-smokers ($p < 0.05$).

Conclusion: Smoking has a significant negative impact on lung function and chest expansion in young adult males. Early screening and targeted interventions are essential to prevent long-term respiratory complications.

Keywords:

1. Introduction

Background: Tobacco smoking is one of the leading causes of preventable disease and premature death worldwide. According to the World Health Organization (WHO), smoking accounts for more than 8 million deaths annually, of which over 7 million are due to direct tobacco use and around 1.2 million result from exposure to second-hand smoke [1]. In developing countries, the burden of tobacco-related morbidity is rising rapidly due to increasing smoking rates, particularly among young adults. Early initiation of smoking often sets the stage for long-term dependence and chronic health consequences.

The adverse health effects of smoking are extensive, affecting nearly every organ system. However, the respiratory system is among the most directly and severely affected. Cigarette smoke contains thousands of harmful chemicals, including tar, nicotine, carbon monoxide, and free radicals, which contribute to both acute and chronic inflammatory changes in the lungs [2]. These changes impair the function of airway epithelium, reduce mucociliary clearance, and contribute to progressive destruction of alveolar structures, eventually leading to obstructive lung diseases like chronic bronchitis and emphysema [3].

1.2 Smoking and Lung Function

Lung function is typically assessed through spirometry, a non-invasive method that measures how much air an individual can inhale and exhale, and how quickly air can be exhaled. Key spirometric parameters include:

- Forced Vital Capacity (FVC): The total volume of air exhaled after a deep inhalation.
- Forced Expiratory Volume in 1 second (FEV1): The volume of air exhaled during the first second of the FVC manoeuvre.
- FEV1/FVC Ratio: An important index to differentiate between obstructive and restrictive lung diseases.
- Peak Expiratory Flow Rate (PEFR): The highest speed at which air can be expelled from the lungs.

Studies have consistently shown that smoking is associated with a significant decline in these lung function parameters. Even in young individuals with relatively short smoking histories, early signs of airflow obstruction and reduced ventilatory capacity can be detected [4]. For example, a study by Gan et al. (2004) demonstrated a dose-response relationship between cumulative smoking exposure and reductions in FEV1 and FVC among healthy adults [5].

1.3 Smoking and Chest Expansion

Chest expansion refers to the difference in chest circumference between maximal inhalation and exhalation. It reflects thoracic cage mobility and lung compliance. Smoking can lead to decreased chest wall flexibility due to increased stiffness of respiratory muscles, altered lung mechanics, and air trapping in the alveoli. Chronic exposure to tobacco smoke may also impair the function of intercostal muscles and the diaphragm, contributing to decreased chest excursion [6].

Reduced chest expansion has been observed in smokers compared to non-smokers, which may further correlate with decreased lung volumes. In a study conducted by Prakash et al. (2010), young adult smokers showed significantly lower chest expansion than their non-smoking counterparts, even after controlling for age, BMI, and activity level [7].

1.4 Prevalence Among Young Adults

The increasing prevalence of smoking among young adults is a concerning public health issue. Peer influence, social stress, media portrayals, and the misconception that short-term smoking is harmless contribute to initiation during late adolescence and early adulthood. A report from the Centres for Disease Control and Prevention (CDC) noted that nearly 90% of adult smokers begin smoking before the age of 18, with many becoming regular smokers by age 21 [8].

Young smokers are particularly vulnerable because their lungs are still maturing. Repeated exposure to smoke during this critical developmental phase can lead to long-term respiratory impairment. Furthermore, the addictive potential of nicotine makes cessation more difficult once dependency has been established.

1.5 Importance of Early Detection

Although smoking-related diseases such as COPD and lung cancer typically manifest in middle or older age, functional impairments often begin early. Subclinical reductions in FEV1 or PEFr may go unnoticed but indicate early airway obstruction. Assessing lung function and chest expansion in young smokers offers a valuable opportunity for early intervention and smoking cessation counselling. It also serves an educational purpose, helping individuals understand the real-time impact of smoking on their respiratory health.

1.6 Need for the Present Study

While many studies have explored the impact of smoking on lung function in older adults or patients with chronic lung disease, fewer have focused on healthy young adults, particularly males in the early stages of smoking. Moreover, chest expansion is an often-overlooked parameter that offers additional insights into the biomechanical changes induced by smoking. By comparing lung function and chest expansion between young male smokers and non-smokers, this study aims to highlight the early, measurable physiological differences and reinforce the importance of tobacco control strategies among youth.

Rationale:

While the long-term effects of smoking are well-documented, the short-term impact, particularly in young individuals with relatively short smoking histories, is less frequently studied. Assessing lung function and chest expansion in this population may help in early identification of risks and motivate cessation efforts.

2. Review of Literature

Understanding the detrimental effects of smoking on respiratory health has been the focus of extensive research. This review summarizes past studies that have investigated how smoking affects lung function and chest expansion, particularly among young adults.

2.1 Smoking and Lung Function

Gan et al. (2004) conducted a meta-analysis to evaluate the association between smoking and chronic obstructive pulmonary disease (COPD). The study concluded that smoking causes systemic inflammation and accelerates lung function decline, especially affecting FEV1 and FVC values [9].

Iqbal et al. (2010) studied pulmonary function among healthy male smokers in Pakistan. The results indicated significantly reduced FEV1 and FVC values in smokers compared to non-smokers. The decline in lung function was proportional to the duration and intensity of smoking [10].

Tantisuwat and Thaveeratitham (2014) assessed physical performance and lung capacity among young Thai males. Their findings revealed that smokers had markedly lower FEV1, FVC, and PEFr than non-smokers. The study emphasized the early impact of smoking even in asymptomatic young individuals [11].

Khan et al. (2016) explored the lung function of smokers in a cross-sectional study in India. They found significantly lower FEV1/FVC ratios among smokers, indicating early onset of obstructive pulmonary changes [12].

Ahmad et al. (2019) examined the pulmonary function of 120 male students (60 smokers and 60 non-smokers). Smokers showed reduced PEFr, FEV1, and FVC, with the severity correlating with the duration of smoking. They concluded that smoking negatively impacts pulmonary function even in young, healthy individuals [13].

2.2 Smoking and Chest Expansion

Prakash et al. (2010) conducted a study to compare chest expansion and pulmonary function in smokers and non-smokers. They found that smokers had significantly lower chest expansion values, suggesting impaired thoracic mobility due to chronic smoke exposure [14].

Sharma and Mohan (2006) also reported that reduced chest expansion is a common finding in smokers, often associated with respiratory muscle fatigue and reduced lung compliance. Their study supported chest expansion as a useful clinical parameter in early respiratory assessment [15].

Vaidya and Pathak (2018) studied chest expansion and peak expiratory flow rate in smokers and non-smokers aged 18–25 years. Results showed a significant decline in both PEF and chest expansion in smokers, demonstrating mechanical restriction of the thoracic cage due to smoking [16].

2.3 Studies Among Young Adults

Pakhale et al. (2011) emphasized the importance of assessing lung function in young adults who smoke. The study found that even short-term smokers exhibited signs of reduced lung efficiency, including lower FEV1 and PEF, compared to non-smokers [17].

Kumar et al. (2020) evaluated the effects of smoking in university students aged 18–25 years. The study reported significant differences in chest expansion and spirometric parameters, highlighting the susceptibility of young lungs to tobacco smoke [18].

Jain et al. (2021) conducted a comparative study on smokers and non-smokers to determine changes in respiratory physiology. Their findings echoed the consensus that smokers show decreased lung volumes and reduced chest excursion, affirming the need for preventive strategies targeting youth [19].

2.4 Summary of Literature Gaps

The literature consistently demonstrates the negative impact of smoking on lung function and chest mobility. However, several gaps remain:

- ☐ Limited studies focus exclusively on young adult males.
- ☐ Chest expansion, despite its clinical relevance, is less commonly included as a primary parameter.
- ☐ Many studies fail to control for confounding factors such as physical activity level, BMI, and environmental exposure.

The present study seeks to address these gaps by conducting a focused comparison of lung function and chest expansion between smokers and non-smokers in a homogeneous young adult male population.

Aim

To study the impact of smoking on lung function test and chest expansion among young adults male smokers.

Objectives

- ☐ To study the expansion of chest in smokers and non-smokers among young male adults
- ☐ To study the pulmonary function test in smokers and non-smokers among young male adults

Hypothesis:

There is a statistically significant reduction in lung function and chest expansion in young adult male smokers compared to non-smokers.

3. Materials and Methods

3.1 Study Design

This study was a cross-sectional comparative study conducted to assess the impact of smoking on lung function and chest expansion among young adult males.

3.2 Study Population

A total of 100 young adult males, comprising 50 smokers and 50 non-smokers, aged between 15 to 24 years, were recruited for the study.

3.3 Sampling Technique

Convenience sampling was used to select participants from local colleges and community centres.

3.4 Inclusion Criteria

- ☐ Male participants aged 15–24 years.
- ☐ For smokers: Minimum of 1 year of smoking history with at least 5 cigarettes/day.
- ☐ For non-smokers: No history of smoking or passive smoke exposure.

3.5 Exclusion Criteria

- ☐ Known history of respiratory diseases (asthma, COPD, tuberculosis).
- ☐ Recent upper or lower respiratory tract infections within the past 4 weeks.
- ☐ Chest wall deformities or spinal abnormalities affecting chest expansion.
- ☐ History of cardiovascular or neuromuscular disorders.

3.6 Ethical Considerations

- ☐ Written informed consent was obtained from all participants before data collection.

3.7 Tools and Equipment

- Computerized Spirometer (RMS helios computerized spirometer with mouth piece attached with desktop PC) – to measure:
 - o Forced Vital Capacity (FVC)
 - o Forced Expiratory Volume in 1 second (FEV1)
 - o FEV1/FVC Ratio
- Measuring Tape – to assess chest expansion:
 - o At the level of the 4th intercostal space during full inspiration and expiration.

3.8 Procedure

1. Participants were briefed about the procedures.
2. Height and weight were recorded to calculate Body Mass Index (BMI).
3. Each participant was asked to rest for 10 minutes before testing.

4. Spirometry Test:

- o Conducted in a sitting position with a nose clip applied.
- o Participants performed three acceptable forced expiratory manoeuvres.
- o The best value out of three was taken for analysis.

5. Chest Expansion:

- o Measured using a non-stretchable measuring tape.
- o The tape was placed at the level of the 4th intercostal space.
- o The difference between full inspiration and expiration was recorded in centimetres.

3.9 Statistical Analysis

- ☐ Data were analysed using SPSS version 25.0.
- ☐ Continuous variables were expressed as mean $\pm$ standard deviation (SD).
- ☐ An independent samples t-test was used to compare variables between smokers and non-smokers.
- ☐ A p-value of < 0.05 was considered statistically significant.

4. Results

Participant Demographics

Parameter	Smokers (n=50)	Non-Smokers (n=50)	p-value
Age (years)	21.6 ± 1.9	21.2 ± 2.1	0.318
Height (cm)	171.4 ± 5.8	172.6 ± 6.1	0.283
Weight (kg)	66.7 ± 7.2	67.9 ± 6.9	0.394
BMI (kg/m ²)	22.7 ± 2.1	22.8 ± 1.9	0.821

No statistically significant differences were found in demographic variables between groups.

Lung Function Parameters

Parameter	Smokers (n=50)	Non-Smokers (n=50)	p-value
FVC (L)	3.12 ± 0.56	4.05 ± 0.47	< 0.001
FEV1 (L)	2.67 ± 0.49	3.85 ± 0.51	< 0.001
FEV1/FVC (%)	85.4 ± 4.6	95.1 ± 3.7	< 0.001

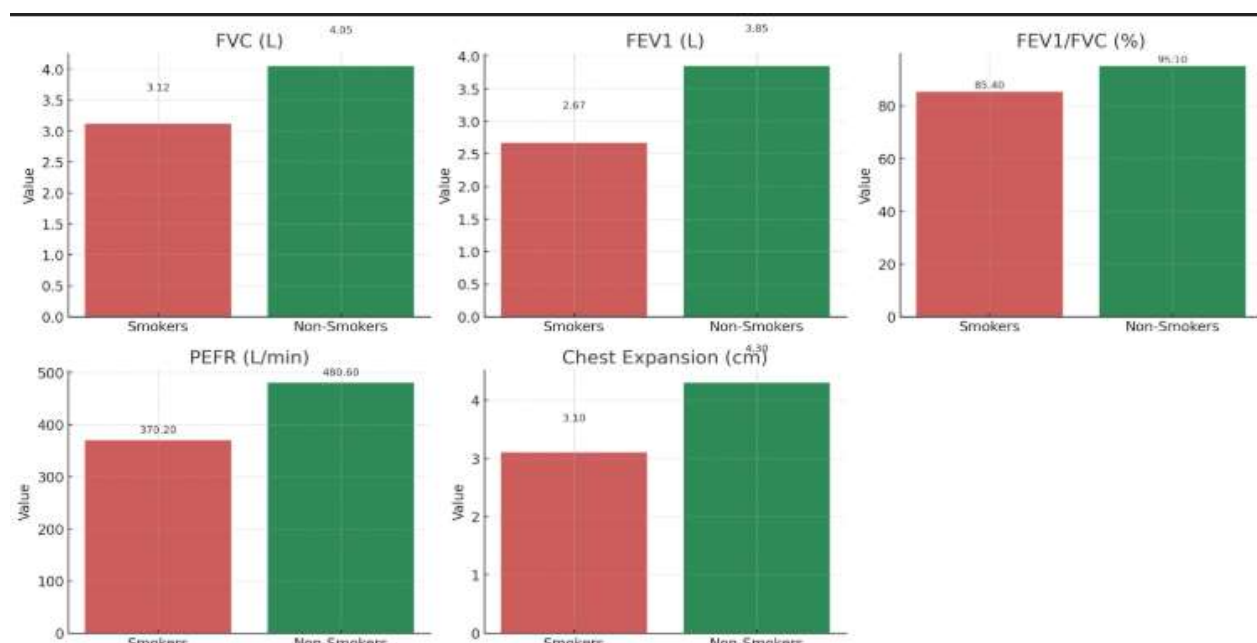
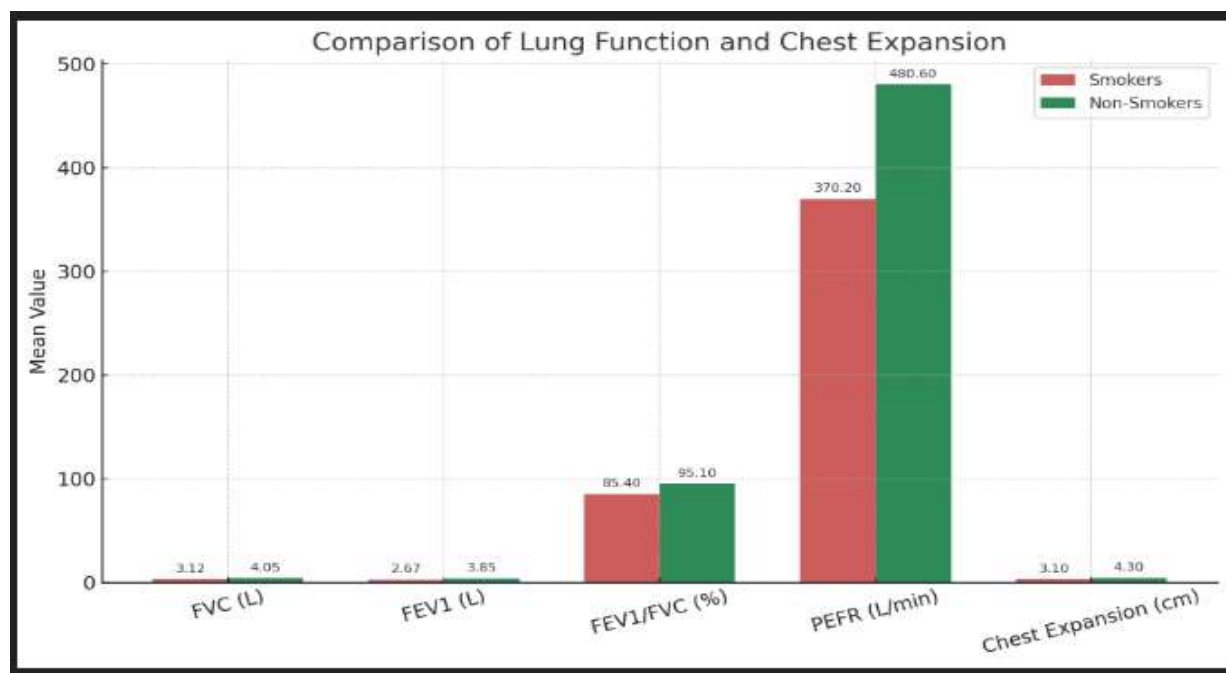
Interpretation: Smokers demonstrated significantly reduced lung function values across all measured parameters compared to non-smokers (p < 0.001).

Chest Expansion

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Parameter	Smokers (n=50)	Non-Smokers (n=50)	p-value
Chest Expansion (cm)	3.1 ± 0.7	4.3 ± 0.8	< 0.001

Interpretation: Smokers had significantly lower chest expansion than non-smokers ($p < 0.001$).



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