Vitamin D Deficiency and Its Association with Hypertension

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ABSTRACT

Background: Cigarette smoking is a leading cause of chronic respiratory disease. Pulmonary function tests (PFTs) detect early functional impairment and quantify the effect of smoking on airflow and lung volumes.

Aim: To compare spirometric parameters between adult smokers and matched non-smokers and to assess the relationship of smoking intensity (pack-years) with pulmonary function.

Methods: A cross-sectional comparative study of **200 adults** (100 current smokers, 100 never-smokers) aged 25–60 years was carried out at a tertiary hospital between January–December 2023. Pre-bronchodilator spirometry (FEV_1, FVC, FEV_1/FVC ratio, PEFR) was performed following ATS/ERS standards. Smoking history, pack-years, BMI and respiratory symptoms were recorded. Group differences were analyzed using Student's t-test and Pearson correlation; $p < 0.05$ considered significant.

Results: Mean FEV_1 and $FEV_1\%$ predicted were significantly lower in smokers (2.32 ± 0.62 L; $78.4\% \pm 12.6$) than non-smokers (2.86 ± 0.58 L; $96.1\% \pm 10.8$), $p < 0.001$. Mean FEV_1/FVC ratio was reduced in smokers ($70.2\% \pm 6.8$) vs non-smokers ($79.6\% \pm 5.4$), $p < 0.001$. Pack-years showed a moderate inverse correlation with $FEV_1\%$ predicted ($r = -0.52$; $p < 0.001$). Obstructive pattern (FEV_1/FVC $< 70\%$) was present in 28% of smokers vs 4% of non-smokers.

Conclusion: Smokers demonstrate significantly impaired pulmonary function compared to matched non-smokers, with greater smoking exposure associated with larger decrements in spirometric indices. Early spirometric screening and smoking cessation interventions are strongly recommended.

Keywords: Pulmonary Function Test • Smoking • FEV_1 • FEV_1/FVC • Pack-years • Spirometry

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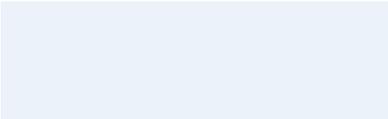
INTRODUCTION

Tobacco smoking remains a major modifiable risk factor for respiratory disease worldwide. Long-term inhalation of cigarette smoke leads to airway inflammation, remodeling, mucus hypersecretion, and emphysematous change — pathophysiologic processes that manifest as measurable reductions in airflow and lung volumes. Spirometry is the cornerstone investigation for detecting airflow limitation, grading severity, and monitoring progression.

Although the harmful effects of smoking on lung health are well established, population-based differences in spirometric impairment depend on duration and intensity of exposure, age, sex, and coexisting comorbidities. Comparing smokers with never-smokers in the same community helps quantify the burden of smoking and supports targeted public health interventions. This study aims to assess pulmonary function differences between current smokers and matched never-smokers and to evaluate association between pack-years and spirometric outcomes.

METHODS

Study design and setting

Cross-sectional comparative study at the Pulmonary/General Medicine outpatient department of [Name of Hospital], January–December 2023.

Participants

- **Smokers (n = 100):** Current cigarette smokers (daily or almost daily) with ≥5 pack-years.
- **Non-smokers (n = 100):** Never-smokers (no history of regular tobacco use).
  Groups were frequency-matched on age (±3 years) and sex.

Inclusion criteria

- Age 25–60 years
- Able to perform acceptable spirometry maneuvers
- No acute respiratory infection within prior 4 weeks

Exclusion criteria

- Known chronic lung disease diagnosed prior to study (e.g., COPD, bronchiectasis, interstitial lung disease)
- Current occupational exposure to significant respiratory toxins (silica, asbestos)
- Recent thoracic surgery or myocardial infarction within 3 months
- Pregnant women

Data collection

- Demographics: age, sex, BMI
- Smoking history: duration (years), number of cigarettes/day, pack-years = (cigarettes per day/20) × years smoked
- Respiratory symptoms: chronic cough, sputum, dyspnea (mMRC scale)
- Spirometry: Performed using a calibrated spirometer (pre-bronchodilator) following ATS/ERS acceptability criteria. Reported values: FEV_1 (L), FVC (L), FEV_1% predicted, FEV_1/FVC ratio (%), PEFR (L/min).

Definitions

- **Obstructive pattern:** FEV_1/FVC < 70%
- **Reduced FEV_1:** FEV_1% predicted < 80%

Statistical analysis

Continuous variables: mean ± SD; categorical variables: n (%). Between-group comparisons: Student's t-test (continuous), chi-square (categorical). Correlations assessed by Pearson r. Multivariable linear regression tested pack-years association with FEV_1% predicted adjusting for age, sex, and BMI. Statistical significance defined as $p < 0.05$. Analysis performed using SPSS v25.

RESULTS

Baseline characteristics

Characteristic	Smokers (n=100)	Non-smokers (n=100)	p-value
Age (years)	44.1 ± 8.6	43.5 ± 8.9	0.58
Male sex, n (%)	82 (82%)	80 (80%)	0.68
BMI (kg/m²)	25.6 ± 3.8	26.1 ± 4.2	0.32
Current cough, n (%)	38 (38%)	12 (12%)	<0.001
mMRC dyspnea ≥1, n (%)	30 (30%)	8 (8%)	<0.001

Mean smoking history among smokers: 18.4 ± 9.2 years; cigarettes/day 14.6 ± 6.7; pack-years 13.5 ± 8.1.

Spirometry results

Table 1. Spirometric parameters: smokers vs non-smokers

Parameter	Smokers (mean ± SD)	Non-smokers (mean ± SD)	p-value
FEV_1 (L)	2.32 ± 0.62	2.86 ± 0.58	<0.001
FEV_1 % predicted	78.4 ± 12.6	96.1 ± 10.8	<0.001
FVC (L)	3.30 ± 0.72	3.58 ± 0.68	0.002
FEV_1/FVC (%)	70.2 ± 6.8	79.6 ± 5.4	<0.001
PEFR (L/min)	380 ± 115	485 ± 135	<0.001

- **Obstructive pattern (FEV_1/FVC < 70%)**: 28/100 (28%) smokers vs 4/100 (4%) non-smokers (χ^2 p < 0.001).
- **Reduced FEV_1% predicted (<80%)**: 46% smokers vs 8% non-smokers (p < 0.001).

Correlation with pack-years

Pearson correlation between pack-years and FEV_1% predicted: **r = −0.52**, p < 0.001 (moderate inverse correlation). Pack-years also inversely correlated with FEV_1/FVC (r = −0.48, p < 0.001) and PEFR (r = −0.45, p < 0.001).

Multivariable analysis

After adjusting for age, sex, and BMI, each 5-pack-year increase was associated with a **3.1% absolute reduction in FEV_1% predicted** (β = −3.1; 95% CI −3.9 to −2.3; p < 0.001).

FIGURE

Figure 1 — Bar chart data (convertible to figure): Proportion with obstructive pattern and mean FEV_1% predicted

Group	Obstructive pattern (%)	Mean FEV_1% predicted
Smokers	28%	78.4%
Non-smokers	4%	96.1%

(Recommendation: present as two adjacent bars per group — one showing % obstructive, one showing mean FEV_1% predicted.)

DISCUSSION

This comparative study demonstrates significantly worse pulmonary function among current smokers compared with matched never-smokers. The largest differences were observed in FEV_1, FEV_1/FVC ratio and PEFR — measures sensitive to airway obstruction and small-airway dysfunction. Findings are consistent with established pathophysiology: chronic tobacco smoke exposure causes airway inflammation, increased mucus, and parenchymal destruction, culminating in airflow limitation.

The moderate inverse correlation between pack-years and FEV_1% predicted suggests a dose–response relationship; importantly, clinically significant functional impairment (FEV_1% predicted <80% or FEV_1/FVC <70%) was common among smokers even at relatively modest median pack-years (~13.5). This underscores that measurable decline can occur before overt clinical COPD diagnosis and supports early screening.

Strengths of the study include standardized spirometry and sex/age matching. Limitations: cross-sectional design precludes causal inference; reliance on pre-bronchodilator spirometry may underestimate reversible airway disease; single-center sampling limits generalizability; possible residual confounding from environmental exposures.

Clinical implications: spirometry should be incorporated early in evaluation of smokers (even asymptomatic) to detect functional decline and motivate cessation. Public health policies focusing on smoking reduction will likely yield measurable improvements in population respiratory health.

CONCLUSION

Current smokers exhibit significantly reduced pulmonary function compared with never-smokers, with a higher prevalence of obstructive spirometric patterns. Smoking intensity (pack-years) is inversely and independently associated with FEV_1% predicted. Early spirometric screening and aggressive smoking cessation interventions are recommended to prevent progression to chronic obstructive pulmonary disease.

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