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# FREQUENCY OF DEEP VEIN THROMBOSIS (DVT) IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD) AT PUNJAB INSTITUTE OF CARDIOLOGY, LAHORE

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**Abstract**

***Background:*** *Chronic Obstructive Pulmonary Disease (COPD) is a major global health issue, contributing significantly to morbidity and mortality. It is frequently associated with comorbidities such as Deep Vein Thrombosis (DVT), a serious venous thromboembolic condition. Understanding the prevalence and risk factors of DVT in COPD patients is essential for improving clinical outcomes.*

***Objective:*** *To determine the frequency of DVT among COPD patients at Punjab Institute of Cardiology, Lahore, and to identify associated demographic and clinical risk factors. Methods: A descriptive cross-sectional study was conducted from August 2023 to January 2024, involving 240 patients aged 30–70 years with a confirmed COPD diagnosis. Doppler ultrasonography was performed to detect DVT. Data on age, gender, smoking history, hypertension, diabetes, obesity, dyslipidemia, disease duration, socioeconomic status, and residential status were collected and analyzed using SPSS version 23.0. Associations were assessed using the chi-square test, with a p-value fi 0.05 considered significant.*

***Results:*** *The prevalence of DVT was 11.3% (27/240 patients). Significant associations were found with smoking history ($p < 0.001$), hypertension ($p < 0.001$), obesity ($p = 0.027$), and disease duration exceeding one year ($p < 0.001$). No significant associations were observed with gender, age, residence, socioeconomic status, diabetes, or dyslipidemia.* ***Conclusion:*** *The study highlights a notable prevalence of DVT among COPD patients, with smoking, hypertension, obesity, and prolonged disease duration as key risk factors. Routine DVT screening and prophylactic measures should be integrated into COPD management to reduce complications and improve patient outcomes.*

## INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a progressive and debilitating respiratory disorder characterized by persistent, largely irreversible airflow limitation. This condition arises from a chronic inflammatory response in the lungs, typically due to prolonged exposure to harmful particles or gases such as tobacco smoke and environmental pollutants. COPD is a major contributor to global health

challenges, significantly increasing rates of illness and death worldwide. According to the World Health Organization, COPD is projected to become the fourth leading cause of death globally by 2030 (Vestbo et al., 2013). This prediction underscores the growing burden of COPD on health systems, particularly in low- and middle-income countries where risk factor exposure is high and healthcare access may be limited (Khan et al., 2012).

The chronic and often progressive nature of COPD leads to frequent hospitalizations due to exacerbations, persistent symptoms, and comorbid conditions. These factors not only increase the economic strain on healthcare systems but also diminish the quality of life for patients. In Pakistan, the burden of COPD is escalating, especially in urban centers like Lahore, due to increasing exposure to environmental and occupational pollutants, tobacco smoke, and indoor biomass fuel usage for cooking and heating. According to Khan et al. (2012), awareness about COPD remains low in Pakistan, leading to underdiagnosis and delayed management. Moreover, indoor and outdoor air pollution, along with poorly ventilated work environments, are among the key contributors to disease development (Kim et al., 2014).

COPD patients often present with multiple comorbidities, including cardiovascular diseases, metabolic disorders, and thromboembolic complications, which further complicate disease management. One of the most serious yet underdiagnosed complications in COPD patients is Deep Vein Thrombosis (DVT)—a condition involving the formation of thrombi in deep veins, typically in the lower extremities. DVT poses a significant risk due to its potential to cause pulmonary embolism (PE) if the clot dislodges and travels to the lungs. The interplay between COPD and DVT is complex and multifactorial. Patients with COPD are at elevated risk for thromboembolic events due to reduced mobility during exacerbations, systemic inflammation, endothelial dysfunction, and blood hypercoagulability. As Kim et al. (2014) noted, COPD itself creates a prothrombotic state, which is further intensified by comorbid conditions such as cardiovascular disease and polycythemia.

Several pathophysiological mechanisms underpin this increased risk. These include prolonged immobility, chronic systemic inflammation, oxidative stress, and the effects of hypoxia on coagulation pathways. Additionally, therapies used to manage COPD, such as corticosteroids and diuretics, may contribute to a prothrombotic state (Duan et al., 2010). Furthermore, many COPD patients exhibit risk factors that are also associated with DVT, such as smoking, sedentary lifestyle, and advanced age.

International data reinforce the need for vigilance in managing thromboembolic risks in COPD patients. For example, a study conducted in Turkey reported a DVT prevalence of 8.3% among COPD patients hospitalized for acute exacerbations (Akturk et al., 2009), while Chinese researchers reported a similar prevalence of 9.7% (Duan et al., 2010). These findings underscore the importance of incorporating thromboprophylaxis into the standard management of hospitalized COPD patients, especially those at high risk. Despite these insights, there remains a notable lack of region-specific data in South Asian contexts, particularly in Pakistan.

The Punjab Institute of Cardiology (PIC), Lahore, stands out as a leading tertiary care institution equipped to investigate the interrelation between COPD and DVT. Serving a diverse patient population from across Punjab, PIC provides both cardiac and pulmonary services, including diagnostic modalities such as D-dimer testing, Doppler ultrasound, and echocardiography. These facilities make PIC an ideal center for a prevalence-based investigation focusing on DVT in COPD patients. Furthermore, the integration of cardiopulmonary care within the same institution enables the exploration of broader comorbid interactions, particularly in patients suffering from overlapping cardiovascular and pulmonary pathologies.

Given that many DVT cases in COPD patients remain clinically silent until complications arise, early diagnosis is crucial. Patients who are immobile due to severe exacerbations or those with prior history of thromboembolic events are particularly vulnerable and should be prioritized for routine DVT screening and pharmacologic prophylaxis, such as low-molecular-weight heparin (LMWH) (Akturk et al., 2009). In a prospective study, it was shown that LMWH significantly reduced the incidence of DVT in hospitalized COPD patients when administered

prophylactically during the course of treatment (Duan et al., 2010).

Understanding the demographic and clinical risk factors that predispose COPD patients to DVT is essential for formulating effective preventive strategies. This includes evaluating the role of advanced age, smoking history, immobility, comorbid cardiovascular conditions, use of steroids, and prior hospitalization. An evidence-based approach to identifying high-risk individuals can help tailor interventions and reduce complications associated with venous thromboembolism. Additionally, there is a need for structured protocols within hospital settings to ensure timely intervention and reduce morbidity and mortality in this high-risk population.

Therefore, the current thesis aims to investigate the prevalence of Deep Vein Thrombosis among patients with Chronic Obstructive Pulmonary Disease at the Punjab Institute of Cardiology, Lahore. The research will focus on identifying key demographic and clinical predictors of DVT, exploring patterns of risk stratification, and proposing clinical recommendations for incorporating DVT prophylaxis into routine COPD management. By contributing to the limited but growing body of regional evidence, this study aims to inform clinical practice and promote policy-level changes that enhance the safety and quality of care provided to COPD patients in tertiary care settings.

Chronic Obstructive Pulmonary Disease (COPD) is a complex, progressive respiratory disorder with widespread systemic implications that extend beyond the lungs. Characterized by chronic inflammation and persistent airflow limitation, COPD has been increasingly linked to a range of extrapulmonary comorbidities, most notably cardiovascular diseases. Among these, venous thromboembolism (VTE)—which includes Deep Vein Thrombosis (DVT) and Pulmonary Embolism (PE)—has gained significant clinical attention due to its potentially fatal consequences (Roversi et al., 2014).

DVT, in particular, presents a serious health concern in patients with COPD. It involves the formation of thrombi within the deep veins, typically in the lower limbs, and may progress to PE if a clot becomes dislodged and travels to the pulmonary arteries. The risk of VTE is amplified in COPD patients due to multiple physiological and clinical factors. These include systemic inflammation, endothelial dysfunction, increased blood viscosity, hypoxemia, and notably, prolonged immobility, especially during episodes of acute exacerbations (Borvik et al., 2015). Collectively, these factors contribute to a prothrombotic state, making COPD patients particularly vulnerable to thromboembolic events.

While this association between COPD and DVT has been increasingly studied in high-income countries, there remains a notable gap in the literature with respect to low- and middle-income nations, particularly Pakistan. The healthcare infrastructure in Pakistan faces challenges such as limited diagnostic resources, inadequate access to preventive care, and delayed recognition of complications. In this context, identifying high-risk subpopulations is vital for effective triage and optimized resource allocation.

**Literature Review**

Chronic Obstructive Pulmonary Disease (COPD) represents one of the most critical public health concerns in the 21st century, ranking among the top five leading causes of mortality worldwide. According to global estimates, COPD accounts for approximately 2.5 million deaths each year, a figure expected to rise in the coming decades due to increased exposure to risk factors and an aging global population (Gomez-Junyent et al., 2014). The Global Initiative for Chronic Obstructive Lung Disease (GOLD) describes COPD as a preventable and treatable condition characterized by persistent respiratory symptoms and irreversible airflow limitation. These symptoms arise from airway and/or alveolar abnormalities, usually caused by significant exposure to harmful particles or gases, especially tobacco smoke (Vestbo et al., 2013).

The global burden of COPD is not evenly distributed. Developing countries bear a disproportionate share of the disease due to compounding risk factors such as poor air quality, limited healthcare access, and a lack of public health awareness. In Pakistan, the incidence and prevalence of COPD have been steadily increasing, particularly in urban centers such as Lahore, Karachi, and Faisalabad, where environmental pollution is pervasive. The high rate of

cigarette smoking, combined with extensive biomass fuel usage for cooking and heating in rural households, significantly elevates exposure to inhaled toxins (Thakrar et al., 2014). Furthermore, genetic predispositions, such as alpha-1 antitrypsin deficiency, though less commonly diagnosed in Pakistan due to a lack of screening, also contribute to disease development in a subset of patients (Agus & Rahman, 2023).

Despite being preventable, COPD remains underdiagnosed, particularly in low-resource settings. Public awareness campaigns have demonstrated some success in promoting early screening and increasing the use of pulmonary function tests (PFTs), as seen in various Pakistani medical centers (Khan et al., 2012). However, much work remains to be done in improving the recognition and management of this chronic illness, particularly regarding its less obvious systemic complications, including venous thromboembolism (VTE).

Deep Vein Thrombosis (DVT) is a serious vascular condition characterized by the development of blood clots (thrombi) within the deep venous system, most commonly in the lower extremities. As a core component of Venous Thromboembolism (VTE), DVT poses significant health risks, particularly when it leads to Pulmonary Embolism (PE), a potentially fatal complication resulting from thrombus migration to the pulmonary arteries. The pathogenesis of DVT is best described by Virchow's triad, which encompasses three key factors: venous stasis, endothelial injury, and a hypercoagulable state (Kim et al., 2014).

In patients with COPD, these three conditions are often simultaneously present. Periods of acute exacerbation are commonly associated with reduced mobility, which predisposes patients to venous stasis. In parallel, systemic inflammation—a hallmark of COPD—damages the vascular endothelium and promotes the activation of coagulation pathways (Morgan et al., 2016). Chronic hypoxemia, frequently observed in advanced COPD, further enhances platelet activation and blood viscosity, thereby contributing to a hypercoagulable state.

Recent literature has confirmed that COPD patients with co-existing DVT or PE have a significantly higher mortality rate compared to those without thromboembolic events (Borvik et al., 2015). This elevated risk underscores the importance of timely detection and prevention of DVT in patients with moderate to severe COPD, particularly during hospitalizations for exacerbation. Despite this, DVT often goes unrecognized in clinical practice, especially in resource-limited settings where diagnostic modalities like D-dimer testing and Doppler ultrasonography are not routinely available (Rudi & Haryono, 2013).

A growing body of international research has demonstrated a consistent association between COPD and DVT, highlighting the importance of considering thromboembolic risk in patients with chronic lung disease. For instance, a Turkish study found a DVT prevalence of 8.3% in hospitalized COPD patients, while a similar study from China reported a 9.7% prevalence in individuals admitted with acute exacerbations (Akturk et al., 2009; Duan et al., 2010). These findings suggest that COPD itself is a predisposing factor for DVT, regardless of ethnic or regional differences.

The pathophysiological mechanisms underlying this association are multifaceted. In addition to systemic inflammation and hypoxia, COPD-related immobility, particularly during severe exacerbations requiring hospitalization, increases venous stasis and slows blood flow. Comorbidities such as coronary artery disease, diabetes mellitus, and heart failure—common in COPD patients—further amplify thrombotic risk (Roversi et al., 2014). Other contributing factors include the use of systemic corticosteroids, polycythemia, and vascular remodeling, all of which are often overlooked during routine COPD management.

Interestingly, a case-control study by Morgan et al. (2016) found that COPD severity directly correlates with increased incidence of VTE, suggesting that advanced-stage COPD patients are at significantly higher risk of thromboembolic events than those with mild disease. This reinforces the need to stratify COPD patients based on severity and to implement prophylactic measures, particularly in hospitalized patients or those with reduced mobility.

Numerous clinical and demographic variables influence the risk of developing DVT among patients with COPD. These include cigarette smoking, obesity, physical inactivity, hypertension, diabetes mellitus, dyslipidemia, and the duration and severity of COPD

itself. Smoking, a major etiological factor in COPD, is also a potent prothrombotic agent. It promotes endothelial dysfunction and accelerates atherosclerosis by triggering oxidative stress and inflammatory cytokine release (Iftikhar et al., 2009). These processes are believed to initiate a cascade of vascular changes that enhance clot formation.

Obesity is another well-established risk factor for DVT, particularly in COPD patients with limited mobility. Excess body weight increases venous pressure, promotes stasis, and exacerbates hypoxemia during sleep and rest. Hypertension and dyslipidemia, common comorbidities in older adults, damage the endothelial lining and promote arterial and venous thrombosis. Mahishale et al. (2015) also reported a high prevalence of metabolic syndrome and insulin resistance in COPD patients, further increasing thrombotic risk.

Additionally, long disease duration contributes to a cumulative inflammatory burden, which may result in vascular remodeling, increased coagulation factor levels, and platelet activation. A prospective cohort study by Le Mao et al. (2017) found that patients with longstanding COPD had a higher risk of recurrent venous thromboembolism, even after initial treatment. Thus, a multidimensional risk assessment that includes lifestyle factors, comorbidities, and disease history is essential for the early identification and prevention of DVT in this vulnerable population.

Despite the growing international awareness of COPD-DVT linkage, regional studies from Pakistan remain limited and fragmented. Waqas et al. (2014), in a study conducted at a tertiary care hospital, observed a male predominance among COPD patients, mirroring trends seen in global datasets. This pattern is often attributed to higher smoking rates among men, occupational exposures, and lower healthcare-seeking behavior among women. In contrast, Ahmad and Zaman (2015) documented a higher prevalence of COPD in females in certain districts of northern Pakistan, especially Peshawar, where indoor air pollution from biomass fuels is prevalent due to traditional cooking methods. This indicates significant regional and gender-based variations in COPD epidemiology across Pakistan.

Another study investigated microbial agents and antibiotic resistance patterns in acute exacerbations of COPD in Karachi, highlighting the complexity of managing comorbid infections in these patients. Collectively, these studies reflect the need for more comprehensive, multi-centered research on COPD and its complications, including DVT, to better inform clinical practice and public health policy.

While a growing body of global literature has confirmed the association between COPD and DVT, there remains a critical gap in region-specific data from South Asia, particularly Pakistan. This lack of local evidence is concerning, especially considering the country's unique demographic, environmental, and socioeconomic profile. Pakistani COPD patients often experience delayed diagnosis, limited access to preventive care, and underutilization of pulmonary rehabilitation and anticoagulation therapy, all of which contribute to worse outcomes.

Moreover, the absence of standardized national protocols for thromboembolism risk screening in COPD patients means that many cases of DVT likely go undetected. As a result, patients may only present after experiencing life-threatening complications like pulmonary embolism. This study seeks to address this critical gap by providing comprehensive, hospital-based data from one of Pakistan's premier cardiopulmonary institutions—the Punjab Institute of Cardiology (PIC), Lahore. By examining the prevalence of DVT, exploring associated clinical risk factors, and analyzing demographic trends in COPD patients, this research aims to generate evidence-based recommendations that can inform clinical guidelines, enhance preventive strategies, and ultimately improve the quality of care for COPD patients across tertiary care settings in Pakistan.

## Methodology

### Study Design and Setting

This study employed a descriptive cross-sectional design to determine the frequency of Deep Vein Thrombosis (DVT) and associated risk factors among patients with Chronic Obstructive Pulmonary Disease (COPD). The research was carried out at the Department of Pulmonology, Punjab Institute of Cardiology (PIC), Lahore, a tertiary care facility that provides specialized cardiopulmonary services and caters to a large and diverse population from across Punjab. The data collection spanned from December, 2023 to January 2024. Ethical approval was obtained from the institutional Ethical Review Committee of

PIC prior to commencement of the study. All procedures were conducted in accordance with the Declaration of Helsinki for human research ethics.
PIC was chosen as the study site due to its integrated cardiopulmonary services, availability of diagnostic modalities including Doppler ultrasonography, and access to a steady flow of COPD patients across various demographics, making it a suitable center for evaluating DVT prevalence and risk profiles in the Pakistani context.

- **Study Population**

The study population consisted of adult patients diagnosed with COPD, who presented to the pulmonology department during the study period. A total of 240 participants were selected through non-probability consecutive sampling, where every eligible COPD patient attending the department during the study timeframe was approached for inclusion.

**Inclusion Criteria:**
- Patients aged 30 to 70 years.
- Clinically diagnosed with COPD for more than 6 months, confirmed by spirometry according to GOLD criteria (Vestbo et al., 2013).
- Willing to provide informed written consent.

**Exclusion Criteria:**
- Patients with congenital heart disease, ischemic heart disease, or history of coronary artery bypass grafting (CABG).
- Those with altered sensorium due to acute COPD exacerbation.
- Patients previously diagnosed with peripheral vascular disease or with pre-existing anticoagulation therapy that may influence DVT outcomes.

These criteria were established to reduce confounding variables that could independently increase the risk of thromboembolism and to ensure the selection of patients whose DVT risk could be primarily attributed to COPD and its direct comorbidities.

- **Sample Size Calculation**

The sample size was estimated using the standard formula for single population proportion, based on the prevalence of DVT in COPD patients (9.7%) as reported by Duan et al. (2010). Assuming a confidence level of 95% and margin of error of 5%, the minimum sample size required was calculated to be 240 participants. This calculation ensured sufficient power to detect statistically significant associations between DVT and various risk factors within the studied population.

- **Data Collection Procedure**

After obtaining informed consent, data were collected using a structured and pre-tested proforma. Information was gathered through face-to-face interviews, clinical examinations, and diagnostic evaluations. The data collection included the following parameters:

- **Demographics**: Age, gender, residential status (urban/rural), and socioeconomic status (low, middle, high).

- **Clinical History**: Duration of COPD, smoking status (current, former, or never smoker), history of comorbid conditions (hypertension, diabetes mellitus, obesity, dyslipidemia).
- Anthropometric Measurements: Weight and height were measured to calculate Body Mass Index (BMI).

- **Biochemical Assessments**: **Fasting blood samples** were drawn to assess lipid profiles, including total cholesterol, LDL, HDL, and triglycerides. Dyslipidemia was defined as per standard NCEP-ATP III guidelines.

- **Diagnostic Evaluation**: **Doppler ultrasonography** of the lower limbs was used to detect the presence of DVT. This was performed by a senior sonologist with over 10 years of post-fellowship experience, using high-resolution duplex ultrasonography. The diagnostic criteria for DVT included non-compressibility of the vein, presence of echogenic thrombus, and absence of venous flow on color Doppler imaging.

**All data were anonymized and coded before entry to maintain participant confidentiality.**

- **Statistical Analysis**

Data analysis was conducted using IBM SPSS Statistics for Windows, Version 23.0. The analysis included both descriptive and inferential statistics:

• Continuous variables (e.g., age, BMI, disease duration) were reported as mean ± standard deviation (SD).
• Categorical variables (e.g., gender, smoking status, socioeconomic class, DVT presence, comorbidities) were presented as frequencies and percentages.

To examine the relationship between DVT and potential risk factors, Chi-square ($\chi^2$) tests were applied for categorical variables. A p-value < 0.05 was considered statistically significant. Where appropriate, binary logistic regression analysis was planned to determine adjusted odds ratios (ORs) and confidence intervals (CIs) for variables significantly associated with DVT.

This statistical approach enabled the study to test hypotheses regarding the prevalence of DVT, identify significant predictors, and explore potential interactions between risk factors, ultimately supporting recommendations for clinical practice and preventive strategies.

## Results

**Based on Table 1:** Demographic and Baseline Data, the study presents a comprehensive overview of the sociodemographic and clinical characteristics of the 240 COPD patients enrolled in the study at the Punjab Institute of Cardiology, Lahore. The majority of patients were in the older age group (51–70 years), accounting for 58.3% (n = 140) of the sample, while the remaining 41.7% (n = 100) were between 30 and 50 years old, indicating a higher disease burden in older individuals. Males comprised 63.3% (n = 152) of the study population, while females accounted for 36.7% (n = 88), which is consistent with global trends showing a male predominance in COPD cases, often linked to higher smoking rates and occupational exposures.

With respect to residence, a slightly higher proportion of patients were from urban areas (51.2%) compared to rural areas (48.8%), reflecting a relatively even distribution and highlighting that COPD affects individuals across both settings. Socioeconomic status revealed that a significant majority of patients (62.5%) belonged to the poor income group, while 37.5% were from middle-income backgrounds, underscoring the socioeconomic burden of COPD and its related complications in low-resource populations. The prevalence of key comorbidities among participants was notable. Diabetes mellitus was present in 25.4% (n = 61) of patients, and hypertension in 44.2% (n = 106), both of which are recognized contributors to increased cardiovascular and thromboembolic risk. Smoking, a major etiological factor for COPD and an independent risk factor for DVT, was reported in 33.8% (n = 81) of patients. Obesity, which contributes to venous stasis and inflammation, was found in 15.0% (n = 36) of participants. When evaluating disease duration, a substantial proportion (66.7%, n = 160) had COPD for more than one year, indicating a chronic disease trajectory with cumulative systemic effects, while 33.3% (n = 80) were within the first year of diagnosis. This finding reinforces the clinical significance of proactively screening for DVT in COPD management, particularly in patients with prolonged disease duration, multiple comorbidities, or reduced mobility.

**TABLE 1 (Demographics)**

| Variable | Number (Percentage) |
|---|---|
| **Age** | |
| 30–50 years | 100 (41.7%) |
| 51–70 years | 140 (58.3%) |
| **Gender** | |
| Male | 152 (63.3%) |
| Female | 88 (36.7%) |
| Residence | |
| Rural | 117 (48.8%) |
| Urban | 123 (51.2%) |
| **Socioeconomic Status** | |
| Poor | 150 (62.5%) |

| | |
|---|---|
| Middle | 90 (37.5%) |
| Diabetes Mellitus | 61 (25.4%) |
| Hypertension | 106 (44.2%) |
| Smoking | 81 (33.8%) |
| Obesity | 36 (15.0%) |
| **Disease Duration** | |
| Up to 1 year | 80 (33.3%) |
| More than 1 year | 160 (66.7%) |
| Dyslipidemia | 63 (26.3%) |
| DVT | 27 (11.3%) |

**Based on Table 2:**

**Non-significant Associations:**

• Gender (p = 0.651): No significant difference was observed between males and females in terms of DVT prevalence. Of the 152 male patients, 18 (11.8%) developed DVT, compared to 9 out of 88 females (10.2%). This suggests that gender was not a significant determinant of thrombotic risk in this study population.

• Age (p = 0.509): The prevalence of DVT was similar across age groups. In the 30–50 years age bracket, 9% (9/100) had DVT, while in the 51–70 years group, the DVT rate was 12.9% (18/140). Despite a slightly higher frequency in the older group, the difference was not statistically significant, indicating age alone did not significantly influence DVT occurrence.

• Residence (p = 0.189): Although DVT appeared more common in urban residents (14.6%) than in rural residents (7.7%), the difference did not reach statistical significance, implying place of residence was not an independent risk factor in this sample.

• Socioeconomic status (p = 0.827): DVT was observed in 11.3% of both the poor and middle-class groups, indicating no socioeconomic disparity in DVT prevalence among COPD patients.

• Diabetes mellitus (p = 0.317): Among diabetic patients, 14.8% (9/61) developed DVT versus 10.1% (18/179) in non-diabetics. Though more common in diabetics, the difference was not statistically significant, suggesting diabetes did not independently increase DVT risk.

• Dyslipidemia (p = 0.324): DVT occurred in 14.3% of dyslipidemic patients and 10.2% of those without dyslipidemia. However, this difference was not statistically significant.

**Significant Associations:**

• Hypertension ($p < 0.001$): A surprising and statistically significant inverse association was found between hypertension and DVT in this study. None of the patients with hypertension (0/106) developed DVT, whereas all 27 DVT cases occurred in patients without hypertension (27/134; 20.1%). This counterintuitive finding may warrant further investigation, as it challenges conventional associations reported in previous studies. Possible explanations include sampling variability or underlying treatment effects, such as antihypertensive medication influencing coagulation pathways.

• Smoking ($p < 0.001$): A highly significant association was observed between smoking and DVT. Among the 81 smokers, 19 (23.5%) developed DVT compared to only 8 (5.0%) among the 159 non-smokers. This highlights smoking as a major prothrombotic factor, likely due to endothelial dysfunction, increased platelet aggregation, and systemic inflammation.

• Disease duration ($p < 0.001$): All 27 DVT cases were in patients with more than 1 year of COPD. None of the patients with disease duration less than or equal to 1 year developed DVT. This strongly suggests that prolonged disease duration significantly increases thrombotic risk, likely due to cumulative inflammation, frequent exacerbations, and reduced mobility over time.

• Obesity (p = 0.027): Interestingly, none of the obese patients (0/36) had DVT, while all DVT cases occurred in non-obese patients. Although statistically significant, this result is unexpected and may reflect measurement bias, misclassification, or confounding factors rather than a true protective effect of obesity. This warrants cautious interpretation and further exploration in larger studies.

Table 2: Comparison of Data Between Patients with and without DVT

| Variable | DVT (n=27) | Normal (n=213) | p-value |
|---|---|---|---|
| **Gender** | | | **0.651** |
| Male (N=152) | 18 | 134 | |
| Female (N=88) | 9 | 79 | |
| **Age** | | | **0.509** |
| 30–50 years (N=100) | 9 | 91 | |
| 51–70 years (N=140) | 18 | 122 | |
| **Residence** | | | **0.189** |
| Rural (N=117) | 9 | 108 | |
| Urban (N=123) | 18 | 105 | |
| **Socioeconomic Status** | | | **0.827** |
| Poor (N=150) | 17 | 133 | |
| Middle class (N=90) | 10 | 80 | |
| **Diabetes Mellitus** | | | **0.317** |
| Yes (N=61) | 9 | 52 | |
| No (N=179) | 18 | 161 | |
| **Hypertension** | | | **<0.001** |
| Yes (N=106) | 0 | 106 | |
| No (N=134) | 27 | 107 | |
| **Smoking** | | | **<0.001** |
| Yes (N=81) | 19 | 62 | |
| No (N=159) | 8 | 151 | |
| **Disease Duration** | | | **<0.001** |
| Up to 1 year (N=80) | 0 | 80 | |
| >1 year (N=160) | 27 | 133 | |
| **Obesity** | | | **0.027** |
| Yes (N=36) | 0 | 36 | |
| No (N=204) | 27 | 177 | |
| **Dyslipidemia** | | | **0.324** |
| Yes (N=63) | 9 | 54 | |
| No (N=177) | 18 | 159 | |



## Chapter 5: Discussion

This study explored the frequency and associated risk factors of Deep Vein Thrombosis (DVT) in patients with Chronic Obstructive Pulmonary Disease (COPD) presenting at the Punjab Institute of Cardiology, Lahore. The findings provide valuable insights into the burden of thromboembolic complications among Pakistani COPD patients and help identify key demographic and clinical predictors of DVT within this specific population.

### Prevalence of DVT in COPD Patients

The prevalence of DVT in the study population was **11.3%**, which is slightly higher than rates reported in earlier studies. For example, Akturk et al. (2009) observed a DVT prevalence of **8.3%** in hospitalized COPD patients in Turkey, while Duan et al. (2010) reported a prevalence of **9.7%** in China. The higher rate observed in this study may be attributed to differences in population characteristics, environmental exposures, diagnostic vigilance, or underlying health care access in Pakistan. The findings are consistent with the global understanding that COPD patients are at a higher risk

of thromboembolic events due to prolonged immobility, systemic inflammation, and hypoxemia (Kim et al., 2014).

**Gender and Age Distribution**

Although male patients constituted the majority of the study sample (63.3%), gender was not significantly associated with DVT ($p = 0.651$). This aligns with Morgan et al. (2016), who suggested that while male predominance in COPD is evident due to higher smoking rates and occupational exposures, gender may not be an independent predictor of DVT. Similarly, no statistically significant association was observed between age groups and DVT prevalence ($p = 0.509$), indicating that the risk of DVT may be more related to disease-specific factors than to chronological age. Nonetheless, older age is often indirectly related to prolonged disease duration, comorbidities, and reduced mobility, which may contribute to thrombotic risk (Le Mao et al., 2017).

**Smoking and Disease Duration: Strong Predictors of DVT**

Among all variables analyzed, **smoking** emerged as a highly significant predictor of DVT ($p < 0.001$). The DVT rate among smokers was 23.5%, far exceeding that of non-smokers (5%). Smoking is a well-established risk factor not only for the development of COPD but also for thrombogenesis, through mechanisms such as endothelial injury, platelet activation, and systemic inflammation (Khan et al., 2012). These findings emphasize the need for aggressive smoking cessation interventions in COPD care plans, not only to slow pulmonary decline but also to reduce thrombotic risks. Additionally, all 27 DVT cases occurred in patients with more than one year of COPD duration, while none were observed in those with disease duration ≤1 year ($p < 0.001$). This strongly supports existing literature suggesting that prolonged disease exposure leads to cumulative inflammatory and prothrombotic changes (Dong et al., 2019). Longstanding COPD is associated with frequent exacerbations, hospitalizations, and sedentary lifestyle—all of which promote venous stasis and clot formation.

**Hypertension and Obesity: Unexpected Findings**

Interestingly, the study found a statistically significant inverse association between hypertension and DVT ($p < 0.001$), as none of the hypertensive patients developed DVT. This contradicts most published evidence where hypertension is considered a contributing factor to vascular dysfunction and thrombosis (Roversi et al., 2014). One possible explanation could be that hypertensive patients were more likely to be on antihypertensive medications such as ACE inhibitors or beta-blockers, which may have protective vascular effects. Alternatively, the association could be a result of selection bias or confounding variables not accounted for in the analysis.

A similarly unexpected result was the absence of DVT among obese patients ($p = 0.027$). This finding opposes the well-established view that obesity increases venous stasis and thrombosis risk (Mahishale et al., 2015). It's possible that obese patients in this study were less mobile and more closely monitored, or that the sample size of obese patients ($n = 36$) was too small to detect true associations. Further studies with larger samples and multivariate analysis are warranted to verify this result.

**Comorbid Conditions: Diabetes, Dyslipidemia, and Residence**

Though diabetes mellitus ($p = 0.317$) and dyslipidemia ($p = 0.324$) were more prevalent among patients with DVT, these associations were not statistically significant. These conditions are frequently linked with metabolic syndrome and systemic inflammation, which can predispose to thrombosis. However, their lack of significance in this study may reflect overlapping risk profiles or confounding effects from smoking and disease duration.

No significant differences were found between urban and rural residents ($p = 0.189$), suggesting that environmental exposure may not be as influential as individual lifestyle and comorbid conditions in DVT development among COPD patients. Similarly, socioeconomic status was not a significant factor ($p = 0.827$), despite the known association between poverty, poor health literacy, and delayed health-seeking behavior. These variables may have an indirect influence but did not show a direct statistical link with DVT in this analysis.

**Public Health Implications**

This study highlights a crucial clinical issue: DVT is not uncommon among COPD patients, and certain risk factors like smoking and prolonged disease duration significantly contribute to this burden. Considering the

resource-constrained setting of Pakistan and the high prevalence of smoking and chronic illness, these findings underscore the importance of:

**Routine DVT screening in long-term COPD patients.**
**Patient education** on smoking cessation and mobility.
Targeted prophylactic strategies in high-risk individuals, especially those with prolonged disease, frequent exacerbations, or limited mobility.

**Limitations of the Study**
While the study provides meaningful insights, certain limitations should be acknowledged:
The **cross-sectional design** prevents assessment of causal relationships.

**The sample was selected using non-probability sampling, which may limit generalizability.**
Certain potentially important variables like physical activity level, use of anticoagulant medication, and frequency of hospitalization were not assessed.
The unexpected inverse associations with hypertension and obesity may be explained by unmeasured confounders and should be interpreted cautiously.

**Conclusion**
In conclusion, the present study demonstrates that DVT is a notable comorbidity in COPD patients, particularly those with a history of smoking and prolonged disease duration. These findings reinforce the need for integrated screening and prevention protocols in tertiary care settings. By identifying high-risk groups and promoting early intervention, health systems in Pakistan and similar low-resource environments can significantly reduce DVT-related complications and improve patient outcomes.

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