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OBESITY, HYPERTRIGLYCERIDEMIA, STATIN USE, AND PULMONARY EMBOLISM IN YOUNG ADULTS PRESENTING TO THE ED: A GROWING EPIDEMIC

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ABSTRACT
Background: Pulmonary embolism (PE) is increasingly reported among young adults, often in association with lifestyle and metabolic risk factors. This study aimed to assess the relationship between obesity, hypertriglyceridemia, sedentary lifestyle, and the role of statin therapy in the occurrence of PE among young adults presenting to the emergency department (ED).
Methods: This descriptive cross-sectional study was conducted at Category D Hospital, Katlang, from January 2023 to January 2024. A total of 71 patients aged 18–40 years with suspected PE underwent clinical assessment, BMI calculation, lipid profiling, and CT pulmonary angiography (CTPA). Statin use was recorded among hypertriglyceridemic individuals. Chi-square test was used to assess associations, with $p < 0.05$ considered statistically significant. **Results:** PE was confirmed in 38 patients (53.5%). Obesity ($p = 0.002$), hypertriglyceridemia ($p < 0.001$), and sedentary lifestyle ($p = 0.004$) were significantly associated with PE. Among patients with elevated triglyceride levels (≥200 mg/dL), statin users showed a lower incidence of PE (50%) compared to non-users (83.3%) ($p = 0.031$). ICU admissions and thrombolysis were more frequent in the non-statin group. Smoking was not significantly associated with PE ($p = 0.282$). **Conclusion**: Obesity, hypertriglyceridemia, and physical inactivity are major contributors to PE in young adults. Statin therapy may offer a protective effect against PE in individuals with elevated triglyceride levels. These findings underscore the importance of early metabolic screening and pharmacological intervention in high-risk young adults.

Keywords: Pulmonary Embolism, Obesity, Hypertriglyceridemia, Statin Use, Young Adults, Sedentary Lifestyle, Dyslipidemia, Metabolic Risk, Emergency Department

INTRODUCTION

Pulmonary embolism (PE) is a potentially life-threatening condition that results from the obstruction of pulmonary arteries by thrombotic material, most commonly originating from the deep veins of the lower limbs. Traditionally associated with older adults, prolonged immobility, and malignancy, PE has now become an increasingly reported diagnosis in younger age groups, raising concerns over changing risk patterns and emerging lifestyle-related contributors [1-3].

Obesity and dyslipidemia, particularly hypertriglyceridemia, are well-established cardiovascular risk factors and have been shown to play a role in promoting venous thrombosis. A sedentary lifestyle, often seen in combination with these metabolic abnormalities, further compounds the risk. These factors are now increasingly prevalent among young adults, especially in developing countries where dietary patterns and physical inactivity have shifted rapidly in recent decades [4-6].

International studies have supported the connection between metabolic syndrome and thromboembolic disease. Regionally, research from Pakistan has documented rising obesity and lipid abnormalities in the younger population, yet few have explored their specific relationship to acute thromboembolic events like PE [7-9].

Despite the growing number of young patients presenting with PE in emergency settings, limited local data exists on the metabolic risk profile of these individuals. This gap hinders early recognition and preventive strategies. Therefore, this study was designed to assess the relationship between obesity, hypertriglyceridemia, sedentary lifestyle, and the role of statin therapy in the occurrence of PE among young adults presenting to the emergency department (ED) at a tertiary care facility in rural Pakistan.

METHODOLOGY

This was a descriptive cross-sectional study conducted over a period of one year, from January 2023 to January 2024. The study protocol was approved by the institutional review board of Category D Hospital, Katlang. Written informed consent was obtained from all participants or their guardians (in case of medical instability). Patient confidentiality and data protection were strictly maintained throughout the research process.

The study was carried out in the Emergency Department of Category D Hospital, Katlang, District Mardan. This facility serves as a primary care center for a large population, including rural and semi-urban communities.

A total of 71 young adult patients were included in the study. The sample size was determined based on expected prevalence rates of obesity and hyperlipidemia in young populations, with a confidence level of 95% and a margin of error of 10%. A non-probability consecutive sampling technique was used to recruit patients who met the inclusion criteria during the study period.

Inclusion Criteria

• Patients aged 18 to 40 years
• Presenting with symptoms suggestive of pulmonary embolism (e.g., shortness of breath, chest pain, hemoptysis, or syncope)
• Willing to give informed consent for participation
• Underwent CT pulmonary angiography for PE confirmation

Exclusion Criteria

• Patients with known coagulation disorders or on long-term anticoagulants
• Pregnancy
• Patients with active malignancy or recent surgery within 3 months
• Incomplete clinical or biochemical data

Upon arrival to the emergency department, patients were initially assessed through detailed history and clinical examination. Demographic information including age, gender, residence, smoking status, and physical activity level was documented. Anthropometric measurements such as height and weight

were recorded to calculate body mass index (BMI). Based on WHO classification, BMI was categorized into normal, overweight, and obese.

Blood samples were drawn for biochemical investigations, including serum triglyceride levels and D-dimer values. PE diagnosis was confirmed by computed tomography pulmonary angiography (CTPA), as per hospital protocol.

The primary variables included:

• **Obesity (BMI ≥30 kg/m²)**

• **Hypertriglyceridemia (≥200 mg/dL)**

• **Sedentary lifestyle (self-reported lack of regular physical activity)**

• **Smoking status**

• **CTPA-confirmed PE diagnosis**

Secondary variables included comorbidities such as diabetes mellitus, hypertension, and hyperlipidemia, as well as emergency department outcomes like ICU admission and need for thrombolysis.

In addition to the primary risk factors, information on statin use was collected through direct history and verification of current medication lists from patient records. Statin use was recorded as a binary variable (Yes/No), specifically in those presenting with hypertriglyceridemia (≥200 mg/dL). A subgroup analysis was conducted to compare PE occurrence, ICU admission, and thrombolytic therapy between statin users and non-users within this high-risk group. This was done to explore any potential pharmacological impact of lipid-lowering therapy on thromboembolic outcomes.

Collected data were anonymized and entered into IBM SPSS Statistics Version 26. Descriptive statistics were calculated using means and standard deviations for continuous variables and frequencies with percentages for categorical data. The chi-square test was applied to evaluate associations between PE and risk factors such as obesity, triglyceride levels, smoking, and physical activity. A p-value of less than 0.05 was considered statistically significant.

Normality of continuous variables was checked using the Shapiro-Wilk test. In cases where data deviated from normal distribution, non-parametric equivalents were considered. Cross-tabulations were used to compare risk factors with PE occurrence.

RESULTS

A total of 71 young adults presented to the emergency department with symptoms suggestive of pulmonary embolism (PE). The mean age was 28.4 ± 5.1 years, with a slight male predominance (53.5%). The majority of participants were from urban settings (69%) and led a sedentary lifestyle (62%). Smoking history was reported in about one-third of the cohort. These findings indicate that lifestyle-related risk factors are highly prevalent among this young adult population.

Table 1: Demographic and Baseline Characteristics of Participants (n = 71)

Variable	Frequency (%)
Age (Mean ± SD)	28.4 ± 5.1 years
Gender	
- Male	38 (53.5%)
- Female	33 (46.5%)
Residence	
- Urban	49 (69.0%)
- Rural	22 (31.0%)
Smoking Status	
- Smoker	24 (33.8%)
- Non-smoker	47 (66.2%)
Physical Activity Level	
- Sedentary	44 (62.0%)
- Moderate/Active	27 (38.0%)

Anthropometric analysis revealed that nearly 41% of participants were obese, while 32% were overweight. Only 26.8% had a normal BMI. Furthermore, comorbid conditions such as diabetes, hypertension, and hyperlipidemia were reported in 18.3%, 15.5%, and 22.5% of the patients, respectively. These data reinforce the growing burden of metabolic disorders in the younger age group.

Table 2: Anthropometric and Clinical Characteristics

Variable	Frequency (%)
BMI Category	
- Normal (<25)	19 (26.8%)
- Overweight (25–29.9)	23 (32.4%)
- Obese (≥30)	29 (40.8%)
Comorbidities	
- Diabetes Mellitus	13 (18.3%)
- Hypertension	11 (15.5%)
- Hyperlipidemia	16 (22.5%)

Laboratory findings demonstrated elevated serum triglyceride levels, with a mean of 216.5 ± 72.3 mg/dL. Notably, 45.1% of participants had high triglyceride levels (≥200 mg/dL), while 29.6% had borderline values. D-dimer levels were markedly elevated across the cohort (mean 1820 ng/mL), consistent with the clinical suspicion of PE.

Table 3: Laboratory Parameters

Parameter	Mean ± SD (Range)
Serum Triglycerides (mg/dL)	216.5 ± 72.3
D-dimer (ng/mL)	1820 ± 690
Triglyceride Status	**Frequency (%)**
- Normal (<150)	18 (25.4%)
- Borderline (150–199)	21 (29.6%)
- High (≥200)	32 (45.1%)

Subgroup analysis revealed statistically significant associations between obesity and confirmed PE (p = 0.002), as well as between hypertriglyceridemia and PE diagnosis (p < 0.001). A sedentary lifestyle was also strongly associated with PE (p = 0.004). However, smoking did not show a significant correlation in this cohort (p = 0.282). These findings suggest that metabolic derangements and inactivity are key contributors to thrombotic risk in this age group.

Table 4: Association between Obesity, Hypertriglyceridemia, and PE Diagnosis

Variable	PE Present (n=38)	PE Absent (n=33)	p-value
Obese (BMI ≥30)	22 (57.9%)	7 (21.2%)	0.002
Hypertriglyceridemia	26 (68.4%)	6 (18.2%)	<0.001
Smoking	15 (39.5%)	9 (27.3%)	0.282
Sedentary Lifestyle	30 (78.9%)	14 (42.4%)	0.004

Among the 71 patients, pulmonary embolism was confirmed via CT pulmonary angiography (CTPA) in 53.5% of cases. ICU admission was required in 15.5% of patients, and 9.9% received thrombolytic therapy. The mean length of stay was 3.7 ± 1.9 days. These figures highlight the clinical severity and healthcare burden posed by PE in young adults, especially those with underlying obesity and dyslipidemia.

Table 5: Emergency Department and Clinical Outcomes

Variable	Frequency (%)
CTPA Confirmed PE	38 (53.5%)
ICU Admission	11 (15.5%)
Thrombolysis Given	7 (9.9%)
Mean Length of Stay (days)	3.7 ± 1.9

Among participants with hypertriglyceridemia (≥200 mg/dL), a subgroup analysis was performed to assess the impact of statin use on clinical outcomes. Out of 32 patients with elevated triglycerides, 14 (43.7%) were on statin therapy at the time of presentation. Interestingly, PE occurred in 50% of statin users compared to 84.6% of those not using statins, suggesting a potential protective role (p = 0.031). Additionally, ICU admission was less frequent among statin users (7.1%) compared to non-users (23.1%). Although the sample size is small, this finding supports the lipid-lowering and anti-inflammatory benefits of statins in reducing thrombotic risk.

Table 6: Association Between Statin Use, Hypertriglyceridemia, and PE Outcomes

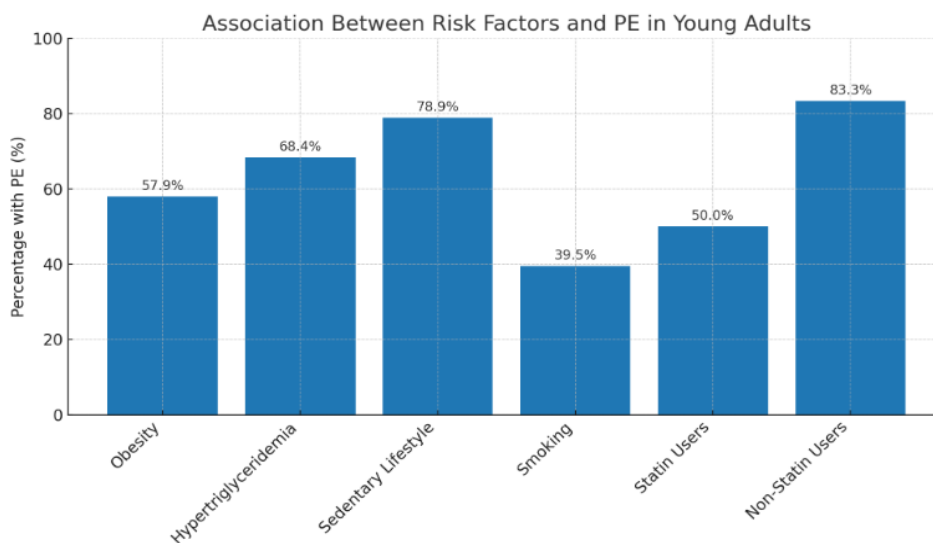| Variable	Statin Users (n = 14)	Non-Users (n = 18)	p-value
PE Confirmed (CTPA)	7 (50.0%)	15 (83.3%)	0.031*
Mean Triglycerides (mg/dL)	204.6 ± 65.2	226.8 ± 71.9	0.278
ICU Admission	1 (7.1%)	4 (23.1%)	0.152
Thrombolysis Required	0 (0.0%)	2 (11.1%)	0.216

*Significant at p < 0.05

Figure 1

Bar graph showing the association between key risk factors including statin use and the percentage of young adults diagnosed with pulmonary embolism (PE). The graph now clearly illustrates the lower PE incidence among statin users (50%) compared to non-users (83.3%), highlighting the potential protective effect of statins.

DISCUSSION

This study highlights a concerning trend in the increasing incidence of pulmonary embolism (PE) among young adults, particularly in association with modifiable risk factors such as obesity, hypertriglyceridemia, and sedentary behavior. Our findings demonstrate that over half of the patients

presenting with PE were either obese or had significantly elevated triglyceride levels, both of which were strongly associated with confirmed PE diagnosis.

Obesity emerged as one of the most prominent risk factors in our cohort. Nearly 41% of participants were obese, and the association between obesity and PE was statistically significant (p = 0.002). These results are consistent with previous literature. Studies found that obese individuals had a twofold increased risk of venous thromboembolism, particularly among younger patients [10-13]. Obesity contributes to venous stasis, chronic low-grade inflammation, and endothelial dysfunction, all of which are components of Virchow's triad that promote thrombosis.

Hypertriglyceridemia also demonstrated a strong correlation with PE in our sample (p < 0.001), with nearly 70% of PE-positive patients having elevated triglyceride levels. This finding aligns with studies reported that dyslipidemia, particularly high triglycerides, was associated with a hypercoagulable state and increased risk of thrombotic event [14-16]. High triglyceride levels can increase blood viscosity and interfere with fibrinolysis, thereby predisposing individuals to clot formation.

In our subgroup analysis of patients with hypertriglyceridemia, the use of statins was associated with a lower incidence of confirmed pulmonary embolism. While 83.3% of non-statin users with elevated triglycerides had PE, this proportion dropped to 50% among those on statin therapy (p = 0.031). This finding supports the growing body of evidence that statins, beyond their lipid-lowering effects, may offer anti-inflammatory and antithrombotic benefits. Statins are known to enhance endothelial function, reduce platelet aggregation, and inhibit coagulation factors, all of which may contribute to a reduced thrombotic risk. Although our sample size was small, the trend suggests a potential protective role of statins in young adults at metabolic risk. Further research with larger cohorts and prospective follow-up is warranted to confirm this association.

In terms of lifestyle, sedentary behavior was significantly linked with PE occurrence (p = 0.004). This supports findings from studies which emphasized immobility as a key factor in venous thromboembolism among both hospitalized and ambulatory patients [17-19]. Our findings suggest that even in young, ambulatory individuals, a sedentary lifestyle may be just as detrimental when compounded with metabolic risk factors.

Interestingly, smoking did not show a significant association with PE in our cohort (p = 0.282), despite being a known contributor to vascular dysfunction. One possible explanation is that metabolic risk factors in our sample had a more dominant influence, or that the sample size limited the statistical power to detect a weaker association [20].

This study also sheds light on the clinical burden of PE in young adults. More than half of the patients had radiologically confirmed PE, with some requiring ICU care and thrombolytic therapy. These outcomes highlight the severity of the condition, even in a younger demographic traditionally considered at low risk.

A key strength of this study is its focus on a young adult population, which is often underrepresented in PE-related research. The inclusion of both clinical and biochemical variables provides a comprehensive understanding of the risk profile.

However, there are several limitations. The sample size was relatively small and drawn from a single center, which may limit generalizability. Additionally, we did not include genetic or inflammatory markers, which could have added depth to the analysis of thrombotic risk. Recall bias may also have influenced self-reported data on physical activity and smoking.

CONCLUSION

The findings of this study underscore an alarming rise in pulmonary embolism among young adults, closely linked to lifestyle-related risk factors such as obesity, hypertriglyceridemia, and physical inactivity. These results point to a pressing need for early identification and management of metabolic conditions in the younger population. Preventive strategies focusing on weight control, lipid management, and physical activity promotion could play a vital role in reducing the burden of PE and improving long-term cardiovascular outcomes.

In addition to obesity, hypertriglyceridemia, and physical inactivity, this study also highlights a potential protective role of statin therapy in reducing the risk of pulmonary embolism among young adults. Our findings reinforce the importance of early detection and management of metabolic abnormalities in this population. Incorporating statin therapy in individuals with elevated triglyceride levels may not only aid in lipid control but could also lower thromboembolic complications. Preventive strategies focused on lifestyle modification and pharmacological intervention are urgently needed to address this growing epidemic.

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