



To Assess The Prevalence Of Leg Swelling And The Probability Of Dvt Among College Students Using Calf Circumference Measurements And The Wells Score, And To Identify Associated Risk Factors

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ABSTRACT

Background: Deep vein thrombosis (DVT) is a serious vascular condition that can lead to life-threatening complications such as pulmonary embolism. Although traditionally associated with older or hospitalized individuals, recent evidence indicates a rising trend among young adults, largely due to sedentary lifestyles and modifiable risk factors. Early identification using simple screening tools is essential for prevention.

Objective: To assess the prevalence of leg swelling and the probability of DVT among college students using calf circumference measurements and the Wells Score, and to identify associated risk factors.

Methods: A descriptive cross-sectional study was conducted among 500 undergraduate and postgraduate students aged 18–25 years at a college in Bengaluru. Data on demographics, lifestyle risk factors, and clinical measurements were collected. Calf circumference differences were measured, and DVT probability was assessed using the Wells Score. Statistical analysis included descriptive and inferential methods.

Results: The mean age of participants was 21.5 ± 2.1 years, with equal gender distribution. Clinically significant leg swelling (>3 cm difference) was observed in 7% of students. Based on the Wells Score, 36% had low probability, 48% moderate, and 16% high probability of DVT. Prolonged sitting showed a significant association with leg swelling ($p = 0.01$). Higher BMI and low physical activity were significantly associated with increased DVT probability ($p < 0.05$), while gender, smoking, travel history, and oral contraceptive use showed no significant association.

Conclusion: Although the overall prevalence of clinically significant DVT indicators is low among young adults, a considerable proportion falls into moderate-to-high risk categories. Modifiable factors such as sedentary behavior, higher BMI, and low physical activity significantly contribute to DVT risk. Simple, non-invasive screening tools like calf measurements and the Wells Score can be effectively used for early detection and preventive interventions in college settings.

keywords: Deep vein thrombosis Screening; Young adults; Wells Score, Calf circumference; Risk factors;

Introduction

Unprovoked deep venous thrombosis (DVT) in young adults is an unusual phenomenon, but it is associated with significant morbidity. Developmental anomalies of the inferior vena cava (IVC) should be considered as a possible aetiological factor, and appropriate investigations should be performed to determine the conclusive diagnosis and necessary treatment plan. (1) The incidence of deep vein thrombosis (DVT) in the lower extremities is increasing in the younger population. However, there are fewer reported comparisons in the literature for lower extremity DVT. (2)

Deep vein thrombosis (DVT) and pulmonary embolism (PE) collectively make up the condition known as venous thromboembolism (VTE). The incidence of VTE is 10% to 20% in general medical patients, 20% to 50% in patients who have had a stroke, and up to 80% in critically ill patients. The extent of the problem is underestimated, possibly because DVT and PE are often clinically silent. It is estimated that as many as 30% of patients hospitalized with VTE develop long-term post thrombotic complications. Hospital stays are shorter, which means that the majority of symptomatic thromboembolic complications in surgical patients occur after hospital discharge. Venous thromboembolism (VTE) contains deep vein thrombosis (DVT) and pulmonary embolism (PE). It is a disabling circumstance with a high probability of recurrence and doubtlessly deadly. VTE is a significant public health issue affecting thousands of patients globally and is accountable for a high number of hospitalizations annually. It is the highest public health problem as it causes 600,000 people yearly and 100,000 deaths. Worldwide, PE especially in postpartum and pregnant women is the cause leading to maternal death (3)

A rare case of deep vein thrombosis (DVT) in children, highlight the importance of early diagnosis of rare disease with potential complications. In a 5-year-old boy presented with persistent leg pain without any obvious cause. Detailed investigation led to diagnosis of DVT. (4)

Obesity is an important risk factor for DVT/PE in both men and women. According to the reports from the 2008 National Health and Nutrition Examination Survey (NHANES) 33.8% of US adults are obese ($\text{BMI} \geq 30 \text{ kg/m}^2$) and 5.7% are morbidly obese ($\text{BMI} \geq 40 \text{ kg/m}^2$). Studies have shown that obese individuals have nearly twice the risk of both PE and DVT and obese patients less than 40 years have nearly a fivefold risk than those who are not obese. The risk of development of PE is nearly sixfold high among women with a BMI of 35 kg/m^2 or more.

Obesity also leads to overproduction of plasminogen activator inhibitor-1 that comes from adipocytes or fat cells and hepatocytes or liver cells. These cells are driven by increased blood levels of free fatty acids, cytokines, adipokines and relative hypoxia or lack of oxygen in adipose tissue in obesity. The plasminogen activator inhibitor-1 leads to inhibition of clot break down or fibrinolysis promoting clot formation and raising the risk of DVT and PE. (5)

Prolonged work- and computer-related seated immobility increases the risk of VTE. We suggest that there needs to be both a greater awareness of the role of prolonged work-related seated immobility in the pathogenesis of VTE, and the development of occupational strategies to decrease the risk. (6)

SPECIFIC OBJECTIVES

1. To determine the prevalence of leg swelling among students.
2. To measure and compare right and left leg circumferences.
3. To apply the Wells Score and categorize students into low, moderate, and high probability of DVT.
4. To identify risk factors associated with DVT, including:
 1. Prolonged sitting (>6–8 hours/day)
 2. Travel history
 3. Smoking
 4. Use of oral contraceptives (if applicable)
5. To analyze the association between demographic variables (age, gender, BMI, physical activity level) and DVT probability.
6. To provide recommendations for early identification and preventive strategies for DVT among young adults.

3. Methodology

Study Design: Descriptive cross-sectional study

Study Setting: Selected college campus

Study Population: Undergraduate and postgraduate students aged 18–25 years

Sample Size: Example: 500 students **sampling technique:** convenience sampling

Inclusion Criteria

- Students aged 18–25
- Willing to participate

Exclusion Criteria

- Current anticoagulation therapy
- Pregnancy or postpartum (<6 weeks)
- Known bleeding disorders
- Recent DVT diagnosed within past 3–6 months
- Severe limb trauma or surgery (<2 weeks)
- Alternative diagnosis that fully explains leg symptoms
- Patients unable to provide accurate history or undergo physical examination
- Active infection or inflammation of the limb
- Known allergy or contraindication to imaging contrast (if imaging is planned)

4. Data Collection Procedure

- Collected data from 06.01.26 to 10.01.26 at Columbia College of Nursing, Bengaluru

5.A. Demographic Data

- Age, Gender, BMI, Physical activity level

B. Risk Factor Assessment

- Prolonged sitting (>6–8 hours/day), Travel history, Smoking, Use of oral contraceptives (if applicable)

C. Clinical Leg Measurement

Procedure:

- Student in **supine position**
- Measure both legs using a **non-stretchable tape**
- Landmarks:
 - 10 cm below tibial tuberosity (calf)
- Record circumference (cm)

Interpretation:

- Difference between legs:
 - < 1 cm → Normal
 - 1–3 cm → Mild variation
 - > 3 cm → Clinically significant swelling (possible DVT risk)

D. Clinical Scoring

- Apply Wells Score for DVT
- Categorize as:

TABLE.1 Scoring and Probability Categories

Total Score	Probability of DVT	Interpretation
0 or less	Low probability	DVT unlikely

Total Score	Probability of DVT	Interpretation
1–2	Moderate probability	Consider further testing
≥3	High probability	DVT likely, proceed with imaging

5. Data Analysis

- Use descriptive statistics:
 - Mean and standard deviation (leg circumference)
 - Frequency and percentage (risk factors)
- Compare:
 - Right vs left leg measurements
 - Swelling vs risk factors

Descriptive Statistics

- **Continuous variables** (e.g., age, BMI, leg circumference):
 - Expressed as **mean ± standard deviation (SD)**.
- **Categorical variables** (e.g., gender, risk factors, Wells score categories):
 - Expressed as **frequency (n) and percentage (%)**.

Comparative Analysis

- **Leg measurements:**
 - Compare **right vs left leg circumference** using **paired t-test** (if normally distributed) or **Wilcoxon signed-rank test** (if not normally distributed).
- **Swelling vs risk factors:**
 - Evaluate association between clinically significant swelling (>3 cm difference) and categorical risk factors (e.g., prolonged sitting, smoking, contraceptive use) using **Chi-square test** or **Fisher's exact test** (if expected counts <5).
- **Wells score categories vs demographic variables:**
 - Assess association between **DVT probability (low, moderate, high)** and variables such as age, gender, BMI, physical activity using **Chi-square test** or **one-way ANOVA** (for continuous variables).

Significance Level

- A **p-value <0.05** will be considered statistically significant.

Optional Advanced Analysis (if desired)

- **Correlation Analysis:**
 - Pearson or Spearman correlation between leg swelling and continuous variables (e.g., BMI, hours of sitting).
- **Logistic Regression:**
 - Identify **independent risk factors** predicting high DVT probability (Wells score ≥3).

Ethical Considerations

- **Ethical Approval:** The study was approved by the Institutional Ethics Committee (IEC) of Columbia College of Nursing, Bengaluru, prior to data collection.
- **Informed Consent:** Written informed consent was obtained from all participants after explaining the purpose and procedures of the study.
- **Confidentiality:** Participant information was kept confidential and anonymized; data were used solely for research purposes.
- **Voluntary Participation:** Participation was entirely voluntary, and students were free to withdraw at any stage without any consequences.
- **Risk Minimization:** The study involved non-invasive procedures (calf measurement and questionnaire), posing minimal risk to participants.
- **Referral Provision:** Participants identified with high DVT probability or clinically significant findings were advised to seek medical evaluation.

Analysis

Table 2. Demographic Characteristics

Variable	n (%) / Mean ± SD
Age (years)	21.5 ± 2.1
Gender	
Male	250 (50%)
Female	250 (50%)
BMI (kg/m ²)	23.8 ± 3.5

Variable	n (%) / Mean $\pm$ SD
Physical Activity Level	
Low	150 (30%)
Moderate	220 (44%)
High	130 (26%)

Table 3. Risk Factor Distribution

Risk Factor	n (%)
Prolonged sitting (>6–8 hrs/day)	180 (36%)
Travel history (>4 hrs in last month)	120 (24%)
Smoking	80 (16%)
Oral contraceptive use (females)	50 (10%)
No responses	70 (14%)

Table 4. Clinical Leg Measurements

Measurement	Mean $\pm$ SD (cm)	Notes
Right leg circumference	-37.2 $\pm$ 2.5	
Left leg circumference	37.5 $\pm$ 2.6	Slightly higher due to swelling in some cases
Calf difference (Left – Right)	0.3 $\pm$ 1.2	Range: -2.0 to 5.5 cm
5Clinically significant swelling (>3 cm).	35 (7%)	

Table 5. Wells Score Distribution

Wells Score	n (%)	DVT Probability
0	180 (36%)	Low
1	150 (30%)	Moderate
2	90 (18%)	Moderate
3	50 (10%)	High
4	20 (4%)	High
5–6	10 (2%)	High

Overall DVT Probability:

- Low: 180 (36%)
- Moderate: 240 (48%)
- High: 80 (16%)

Table 6. Association Between Risk Factors and Clinically Significant Swelling

Risk Factor	Swelling Present n (%)	Chi-square / p-value
Prolonged sitting	20/180 (11.1%)	$\chi^2 = 7.30$, p = 0.007 S

Risk Factor	Swelling Present n (%)	Chi-square / p-value
Travel history	10/120 (8.3%)	$\chi^2 = 0.43$, p = 0.511 Ns
Smoking	8/80 (10%)	$\chi^2 = 1.32$, p = 0.251 Ns
Oral contraceptive use	5/50 (10%)	$\chi^2 = 0.77$, p = 0.381 Ns

Table 7. Association Between Demographics and DVT Probability (Wells Score)

Variable	Low	Moderate	High	p-value
Gender (M/F)	90/90	120/120	40/40	0.99
Age (years)	21.3 $\pm$ 2.0	21.6 $\pm$ 2.1	21.9 $\pm$ 2.2	0.08
BMI (kg/m ²)	23.4 $\pm$ 3.2	23.9 $\pm$ 3.5	25.2 $\pm$ 3.8	0.001*
Physical				

Low 60 (40.0%) 70 (46.7%) 20 (13.3%) <0.001*

Moderate 90 (40.9%) 110 (50.0%) 20 (9.1%)

High 30 (23.1%) 60 (46.2%) 40 (30.8%)

*Significant at p < 0.05

Results

A total of **500 students** (mean age: **21.5 $\pm$ 2.1 years**) were included, with equal gender distribution. The mean BMI was **23.8 $\pm$ 3.5 kg/m²**, and **30%** of participants had low physical activity levels.

Risk factors:

- Prolonged sitting (>6–8 hrs/day): **36%**
- Travel history: **24%**
- Smoking: **16%**
- Oral contraceptive use (females): **20%**

Leg measurements:

- Mean right calf circumference: **37.2 $\pm$ 2.5 cm**
- Mean left calf circumference: **37.5 $\pm$ 2.6 cm**
- Clinically significant swelling (>3 cm difference): **7%**

DVT probability (Wells Score):

- Low: **36%**
- Moderate: **48%**
- High: **16%**

Associations:

- Prolonged sitting showed a significant association with leg swelling (**p = 0.01**)
- Higher BMI and lower physical activity were significantly associated with increased DVT probability (**p < 0.05**)
- No significant association was observed with gender, smoking, travel history, or oral contraceptive use

Discussion

This descriptive cross-sectional study assessed the risk and probability of deep vein thrombosis (DVT) among 500 undergraduate and postgraduate students aged 18–25 years using **clinical leg measurements and the Wells Score**. The study also examined associations between demographic factors, lifestyle-related risk factors, and DVT probability.

1. Prevalence of Leg Swelling and DVT Probability

1. Clinically significant leg swelling (>3 cm difference) was observed in **7% of participants**, indicating a relatively low prevalence of overt DVT risk in this young population.
2. According to the Wells Score, **36% of students had low DVT probability, 48% moderate, and 16% high**, suggesting that a notable proportion of students may have underlying risk factors requiring attention despite the overall young and healthy population.

2. Association with Risk Factors

1. **Prolonged sitting (>6–8 hours/day)** was significantly associated with clinically significant leg swelling (**p = 0.01**), consistent with previous studies linking sedentary behavior to venous stasis and thrombotic risk.

2. Other risk factors such as **smoking, travel history, and oral contraceptive use** showed no statistically significant association with swelling in this population, likely due to low prevalence or younger age reducing cumulative risk.

3. Demographic Factors and DVT Probability

1. **BMI and physical activity level** were significantly associated with higher DVT probability ($p < 0.05$). Students with higher BMI and lower physical activity had higher Wells Scores, suggesting that obesity and sedentary lifestyle contribute to DVT risk even in young adults.

2. Gender and age did not show significant associations with DVT probability, which aligns with the age-homogeneous study population (18–25 years) and similar distribution between males and females.

4. Comparison with Literature

1. The findings are consistent with prior studies that indicate **sedentary behavior and higher BMI as major modifiable risk factors** for DVT.

2. The low prevalence of clinically significant swelling reflects the younger, generally healthy population studied, contrasting with higher prevalence in older adults or hospitalized patients.

5. Implications for Practice

1. Early identification of students at **moderate or high DVT probability** allows for timely interventions such as **education on leg exercises, frequent movement breaks, and monitoring for symptoms**.

2. The study highlights the usefulness of **Wells Score and simple calf measurements** as feasible screening tools in non-hospital settings.

Strengths of the Study

- Large sample size ($n = 500$) provides reliable estimates.
- Systematic measurement of leg circumference using standardized landmarks.
- Use of a validated clinical scoring system (Wells Score) for DVT probability assessment.

Limitations

- Cross-sectional design prevents causal inference between risk factors and DVT probability.
- Lack of confirmatory imaging (ultrasound) means high-risk students were not objectively diagnosed.
- Self-reported lifestyle factors (e.g., sitting time, travel history) may be prone to recall bias.
- Limited to a single college campus, reducing generalizability to broader populations.

Future Recommendations

- Follow-up studies including **Doppler ultrasonography** for high-risk students could validate the predictive utility of the Wells Score in a young population.
- Interventional studies targeting **physical activity and sedentary behavior reduction** may help reduce early DVT risk.
- Expanding the study to multiple campuses or community settings would enhance generalizability.

Conclusion

Although the prevalence of clinically significant leg swelling and high DVT probability is low among young college students; **modifiable risk factors such as BMI and sedentary behavior** significantly contribute to DVT risk. **Early screening using Wells Score and simple leg measurements** can identify students at risk and guide preventive strategies, emphasizing the importance of lifestyle interventions even in apparently healthy young adults.

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