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Original Research Article

Clinical Manifestations and Etiological Factors of Chronic Venous Disease: A Multicenter Cross-Sectional Study in Bangladesh

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Abstract: ***Background*:** Chronic venous disease (CVD) is a progressive condition with a wide range of presentations, from asymptomatic telangiectasias to active venous ulcers. Despite its significant burden, limited multicenter data exist on the clinical manifestations and risk factors of this condition in Bangladesh. The study aims to evaluate the clinical profiles, etiological factors, and complication patterns of CVD using the CEAP classification system among Bangladeshi patients. ***Methods:*** A multicenter cross-sectional study was conducted at the National Institute of Cardiovascular Diseases and selected private vascular clinics. A total of 470 participants aged ≥18 years with suspected CVD were consecutively recruited. Data on demographics, occupational factors, symptoms, and risk factors were collected using structured questionnaires and physical examinations. Duplex ultrasonography confirmed diagnoses. Disease severity was categorized using the CEAP classification, and logistic regression identified predictors of advanced disease (C3–C6). ***Results:*** The mean age was 45.2 ± 12.7 years; 53.6% were male. The most common CEAP stage was C2 (varicose veins, 35.1%), followed by C3 (edema, 16.8%) and C6 (active venous ulcer, 9.6%). Early stages (C0–C1) accounted for 18.1%. Leg pain (62.8%) and heaviness (59.8%) were predominant symptoms, while edema (34.0%) and venous ulcers (16.6%) reflected advanced disease. Key risk factors included prolonged standing (39.4%), age ≥50 years (42.1%), female sex (46.4%), obesity (23.8%), family history (25.7%), and low socioeconomic status (30.4%). Complication rates increased progressively from 3.6% in C0 to 77.8% in C6 ($p < 0.001$). Obesity and prolonged standing were significantly associated with severe disease. ***Conclusion:*** CVD in Bangladesh most frequently presents with varicose veins, with many patients progressing to ulcerative stages. Occupational and lifestyle risk factors strongly influence disease progression, highlighting the need for early screening, preventive strategies, and targeted interventions for high-risk groups.

Keywords: Chronic Venous Disease, Varicose Veins, CEAP Classification, Risk Factors, Bangladesh.

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Introduction

Chronic venous disease (CVD) encompasses a spectrum of venous disorders affecting the lower limbs, ranging from asymptomatic telangiectasias (Clinical class C1) to debilitating conditions such as varicose veins (C2), edema (C3), skin changes (C4), healed ulcers (C5), and active venous ulcers (C6) as per the widely adopted CEAP classification (Clinical–Etiologic–Anatomic–Pathophysiologic.[1, 2] This robust framework facilitates standardized disease

categorization, enhances comparability across studies, and aids clinical decision-making.[3] Globally, CVD represents a significant public health challenge. Prevalence estimates vary by geography, affecting approximately 2% to 73% of populations depending on definitions and methodologies used.[4] Clinical manifestations such as pain, heaviness, swelling, and tingling in the lower legs are among the most common symptoms and significantly impair health-related quality of life.[4] Given its progressive nature, complications of advanced CVD can impose substantial healthcare and economic burdens, particularly in resource-limited settings where awareness and access to specialized vascular care are limited.

In South Asia, data remain limited but indicative of considerable disease burden. A multicenter cross-sectional study in Pakistan reported a CVD prevalence of 34.8%, with clinical class C3 (edema) being most common (36.7%), followed by varicose veins (C2) at 15.8%.[5] Leg pain, heaviness, and night cramps were the most frequent symptoms; risk factors included family history and sedentary lifestyles.[5] In the context of Bangladesh, evidence is even scarcer. A prospective observational study conducted at the National Institute of Cardiovascular Diseases (NICVD) in Dhaka evaluated 180 patients with confirmed CVD. Among these, 35% presented with C2 stage varicose veins, while advanced skin changes classified as C4b (lipodermatosclerosis or atrophie blanche) had the lowest prevalence (11.7%).[6] These findings underscore the clinical burden among referral populations but fall short of offering comprehensive insights into the broader epidemiology and etiology of CVD in Bangladesh. Few multicenter studies have explored the clinical presentation and etiological factors of chronic venous disease (CVD) in Bangladesh. Key demographic characteristics (age, sex, socioeconomic status), occupational exposures, and modifiable risk factors like obesity remain underexamined in relation to disease severity as classified by CEAP. Addressing this gap is crucial for developing targeted prevention and management strategies. This study aims to identify high-risk groups and understand the clinical and etiological profiles of CVD patients, which will aid in resource allocation, patient education, and training in vascular care.

Methods

Study Design

This was a multicenter, cross-sectional observational study conducted between January, 22 and February, 2025 at the National Institute of Cardiovascular Diseases (NICVD), Dhaka, and selected private vascular clinics in Bangladesh. The multicenter approach was adopted to capture a representative spectrum of patients presenting with suspected chronic venous disease (CVD) across diverse healthcare settings, including tertiary referral centers and community-based outpatient clinics.

Study Population

Inclusion Criteria

Patients aged ≥18 years presenting with suspected CVD, defined as any lower limb venous symptom (e.g., swelling, heaviness, varicosities, pigmentation changes, or ulceration).

Exclusion Criteria

Patients with acute deep vein thrombosis, prior venous surgery, or severe comorbid conditions precluding assessment were excluded to ensure diagnostic clarity and data integrity.

Diagnostic confirmation

All enrolled participants underwent a comprehensive assessment, including:

Clinical history and physical examination to identify presenting symptoms (leg pain, heaviness, edema, pigmentation, ulceration) and potential etiological factors (family history, occupational exposures, obesity).

Duplex ultrasonography to evaluate venous reflux, obstruction, and anatomical involvement, performed by certified vascular sonographers following standard protocols (pmc.ncbi.nlm.nih.gov).

Castratory test, when indicated, to confirm the hemodynamic significance of superficial or deep venous reflux.

Participants were subsequently classified according to the CEAP (Clinical–Etiologic–Anatomic–Pathophysiologic) system, with stages ranging from C0 (no visible signs) to C6 (active venous ulceration).

Clinical Classification of CEAP

The severity of chronic venous disease (CVD) among participants was classified using the Clinical–Etiologic–Anatomic–Pathophysiologic (CEAP) classification system, as recommended by the

American Venous Forum and the Society for Vascular Surgery guidelines (7,8). For this study, only the clinical component (C0–C6) was applied to categorize disease severity based on physical examination and duplex ultrasonography findings.

C0 – No visible or palpable signs of venous disease
C1 – Telangiectasias or reticular veins
C2 – Varicose veins (diameter ≥3 mm)
C3 – Edema without skin changes
C4a – Pigmentation or eczema
C4b – Lipodermatosclerosis or atrophie blanche
C5 – Healed venous ulcer
C6 – Active venous ulcer

Participants were clinically assessed and categorized into the appropriate CEAP stage by trained vascular specialists following standardized protocols to ensure reliability and reproducibility. Duplex ultrasonography was used to confirm venous reflux and anatomical involvement. This classification provided a structured approach to stratify patients by disease severity, facilitating comparisons across subgroups and aligning with international reporting standards.

Sample Size

The sample size was calculated using the following standard formula for a single proportion:

$$n_0 = \frac{Z^2\, p\,(1-p)}{d^2}$$

Where, Z = 1.96 for 95% confidence, P = 35% (e.g., 0.35) (anticipated prevalence of C2 stage varicose veins, based on NICVD referral data), d=0.05 (absolute precision).[6] The minimum required sample (n0) was 350. Adjusting for a design effect of 1.2 to account for multicenter sampling and 10% non-response, the final target sample was 470 participants.

Sampling and Recruitment

Participants were recruited using consecutive sampling at each study site until the required sample size was achieved. Proportionate allocation was applied across centers based on patient flow, ensuring that each site contributed a representative share of participants relative to its volume of suspected CVD cases. All participants provided written informed consent before enrollment. Recruitment and data collection procedures were standardized across all centers, and trained research assistants supervised data entry to ensure quality and consistency.

Variables and Measurements

The study captured a comprehensive set of variables across four domains. Socio-demographic variables included age, sex, occupation, and socioeconomic status. Anthropometric measurements comprised height, weight, and body mass index (BMI), with obesity classified according to WHO criteria. Clinical manifestations recorded included leg pain, heaviness, edema, skin pigmentation changes, and ulcers. Etiological factors considered were family history, occupational exposure (prolonged standing), and obesity. All participants were classified using the CEAP system (C0–C6) to determine disease severity.

Data Collection Procedure

Data were collected using a structured questionnaire capturing demographics, occupational exposure, lifestyle factors, and symptoms. Clinical examinations were performed by trained vascular specialists to document signs of CVD. Duplex ultrasonography was used to confirm venous reflux, obstruction, and anatomical involvement. All data were systematically entered into STATA version 17, with routine checks for accuracy and completeness.

Statistical Analysis

Descriptive statistics were used to summarize continuous variables as mean ± SD or median (IQR) and categorical variables as frequencies and percentages. Inferential statistics included Chi-square or Fisher's exact tests for categorical associations and t-tests/ANOVA for continuous variables. Multivariable logistic regression was applied to identify independent predictors of moderate-to-severe CVD (CEAP C3–C6), reporting odds ratios with 95% confidence intervals. Statistical significance was defined as $p < 0.05$.

Ethical Considerations

The study protocol received approval from the Institutional Review Board (IRB) of National Institute of Cardiovascular Diseases, Dhaka, Bangladesh. Written informed consent was obtained from all participants. Participant confidentiality was strictly maintained using anonymized data coding and secure storage. All procedures adhered to the Declaration of Helsinki and local ethical regulations.

Results

Socio-demographic and anthropometric characteristics

The study included a total of 470 participants with a mean age of 45.2 ± 12.7 years. Among them, 252 (53.6%) were male and 218 (46.4%) were female. The mean BMI of the participants was 27.4 ± 4.8 kg/m², with 112 individuals (23.8%) classified as obese based on a BMI ≥30 kg/m². Regarding occupational distribution, 185 participants (39.4%) were engaged in professions requiring prolonged standing for more than six hours per day, 128 (27.2%) had sedentary occupations, and 157 (33.4%) were involved in mixed or other types of work. In terms of socioeconomic status, the majority were from the low socioeconomic group 284 (60.4%), followed by 124 (26.4%) from the middle-income group and 62 (13.2%) from the high-income group (Table 1).

Table 1: Socio-Demographic and Anthropometric Characteristics (n = 470)

Variable	n (%) or mean ± SD
Age (years)	45.2 ± 12.7
Sex	
Male	252 (53.6)
Female	218 (46.4)
BMI (kg/m²)	27.4 ± 4.8
Obesity (BMI ≥30 kg/m²)	112 (23.8)
Occupation	
Prolonged standing (>6 h/day)	185 (39.4)
Sedentary	128 (27.2)
Mixed/Other	157 (33.4)
Socioeconomic status	
Low	284 (60.4)
Middle	124 (26.4)
High	62 (13.2)

Prolonged standing occupation includes teachers, factory workers, retail shop workers, surgeons, security guards, waiters/waitresses, hairdressers, etc.; Sedentary occupation includes office workers, computer operators, call center staff, bankers, drivers, etc.; and Mixed/Other occupation includes nurses, farmers, field health workers, construction workers, police officers, etc.

CEAP Classification Distribution

Among the 470 participants, 28 (6.0%) were classified as C0, indicating no visible signs of chronic venous disease. C1 stage was observed in 57 participants (12.1%), while C2 stage (varicose veins) was the most common, present in 165 participants (35.1%). C3 stage (edema) was identified in 79 participants (16.8%). In the C4 category, 42 participants (8.9%) had C4a changes, including pigmentation or eczema, and 21 (4.5%) had C4b changes, such as lipodermatosclerosis or atrophic blanche. C5 stage, representing healed venous ulcers, was recorded in 33 participants (7.0%), while C6 stage, indicating active venous ulcers, was found in 45 participants (9.6%) (Table 2).

Table 2: CEAP Classification Distribution (n = 470)

CEAP Stage	n (%)
C0 (No visible signs)	28 (6.0)
C1 (Telangiectasias / reticular veins)	57 (12.1)
C2 (Varicose veins)	165 (35.1)
C3 (Edema)	79 (16.8)
C4a (Pigmentation/eczema)	42 (8.9)
C4b (Lipodermatosclerosis/atrophie blanche)	21 (4.5)
C5 (Healed venous ulcer)	33 (7.0)
C6 (Active venous ulcer)	45 (9.6)

Common Clinical Manifestations

Among the 470 participants, leg pain was reported by 295 individuals (62.8%), while 281 (59.8%) experienced leg heaviness. Edema was observed in 160 participants (34.0%), and varicosities were visibly present in 165 participants (35.1%). Pigmentation or other skin changes were documented in 103 participants (21.9%), and night cramps were reported by 102 participants (21.7%). Venous ulcers were identified in 78 participants (16.6%) (Table 3).

Table 3: Common clinical manifestations (n = 470)

Symptom / Sign	n (%)
Leg pain	295 (62.8)
Leg heaviness	281 (59.8)
Edema	160 (34.0)
Pigmentation/skin changes	103 (21.9)
Venous ulcers	78 (16.6)
Night cramps	102 (21.7)
Varicosities visible	165 (35.1)

Etiological and Risk Factors

Among the 470 participants, 121 individuals (25.7%) reported a family history of chronic venous disease (CVD). Prolonged standing occupation was noted in 185 participants (39.4%), and obesity (BMI ≥30 kg/m²) was present in 112 participants (23.8%). Age ≥50 years

was observed in 198 participants (42.1%), and the study population consisted of 218 female participants (46.4%). Low socioeconomic status was recorded in 143 participants (30.4%) (Table 4).

Table 4: Etiological or Risk Factors (n = 470)

Risk Factor	n (%)
Family history of CVD	121 (25.7)
Prolonged standing occupation	185 (39.4)
Obesity (BMI ≥30 kg/m²)	112 (23.8)
Age ≥50 years	198 (42.1)
Female sex	218 (46.4)
Low socioeconomic status	143 (30.4)

CEAP Stage by Obesity and Prolonged Standing

Among the 112 participants classified as obese (BMI ≥30 kg/m²), 15 (13.4%) were in C0–C1 stages, 40 (35.7%) in C2, 20 (17.9%) in C3, 15 (13.4%) in C4, 10 (8.9%) in C5, and 12 (10.7%) in C6. Among the 185 participants with prolonged standing occupations, 24 (13.0%) were in C0–C1 stages, 67 (36.2%) in C2, 33 (17.8%) in C3, 27 (14.6%) in C4, 16 (8.6%) in C5, and 18 (9.7%) in C6 (Figure 1).

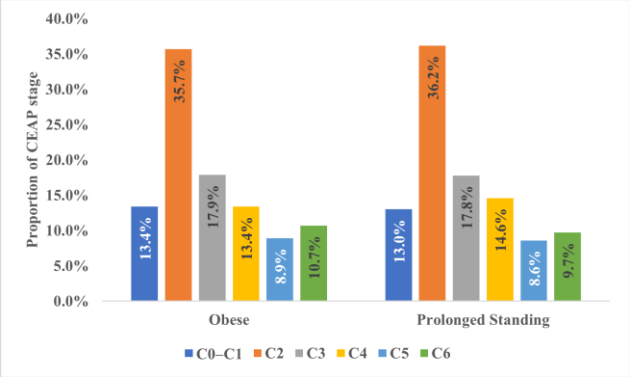

Figure 1: CEAP Stage by Obesity and Prolonged Standing

Association Between CEAP Stage and Complications

Among the 470 participants, the C0 stage included 28 individuals (6.0%), with 1 participant (3.6%) experiencing complications, serving as the reference group. C1 stage included 57 participants (12.1%), with 3 (5.3%) having complications (OR 1.50, 95% CI 0.15–14.9; p = 0.732). In the C2 stage, 165 participants (35.1%) were identified, with 18 (10.9%) experiencing complications (OR 3.39, 95% CI 0.5–22.8; p = 0.224). For the C3 stage, 79 participants (16.8%) were included, with 22 (27.8%) having complications (OR 10.3, 95% CI 1.5–69.5; p = 0.020). In the C4 stage, 63 participants (13.4%) were documented, with 30 (47.6%) experiencing complications (OR 24.0, 95% CI 3.6–158.0; p < 0.001). C5 stage included 33 participants (7.0%), with 20 (60.6%) having complications (OR 42.0, 95% CI 6.0–290.0; p < 0.001). Finally, the C6 stage included 45 participants (9.6%), with 35 (77.8%) experiencing complications (OR 92.0, 95% CI 13.0–650.0; p < 0.001) (Table 5).

Table 5: Association Between CEAP Stage and Complications (n = 470)

CEAP Stage	n (%)	Complication** Present n (%)	Odds Ratio (95% CI) ***	p-value
C0	28 (6.0)	1 (3.6)	Reference	–
C1	57 (12.1)	3 (5.3)	1.50 (0.15–14.9)	0.732
C2	165 (35.1)	18 (10.9)	3.39 (0.5–22.8)	0.224
C3	79 (16.8)	22 (27.8)	10.3 (1.5–69.5)	0.020*
C4	63 (13.4)	30 (47.6)	24.0 (3.6–158.0)	<0.001*
C5	33 (7.0)	20 (60.6)	42.0 (6.0–290.0)	<0.001*
C6	45 (9.6)	35 (77.8)	92.0 (13.0–650.0)	<0.001*

C0: No visible signs, C1: Telangiectasias / reticular veins, C2: Varicose veins, C3: Edema, C4a: Pigmentation / eczema, C4b: Lipodermatosclerosis / atrophie blanche, C5: Healed venous ulcer, C6: Active venous ulcer. **Complications include venous ulcers, pigmentation changes, lipodermatosclerosis, and recurrent edema. ***Odds ratios calculated relative to C0–C1 (reference group). *p-value <0.05 indicates a statistically significant association.

Discussion

In this study, the C2 stage (varicose veins) was the most prevalent, occurring in 35.1% of participants, followed by C3 (edema) at 16.8% and C6 (active venous ulcer) at 9.6%. Early stages (C0–C1) comprised 18.1% of the participants. This distribution aligns with global trends showing varicose veins as the most common clinical presentation of chronic venous disease (CVD), while advanced stages are less frequent but clinically significant.[9, 10] Comparable prevalence patterns have been reported in South Asian populations, with C2 predominating and lower proportions in C5–C6 stages.[11-13] The distribution underscores the progressive nature of CVD, with early identification of C2 patients being critical for preventing complications. The most commonly reported symptoms were leg pain (62.8%) and heaviness (59.8%), while edema (34.0%), visible varicosities (35.1%), pigmentation/skin changes (21.9%), night cramps (21.7%), and venous ulcers (16.6%) were also observed. These findings are

consistent with prior epidemiological studies, which document pain, heaviness, and edema as the predominant subjective complaints in CVD, and ulcers and skin changes as hallmark complications of advanced stages.[14] The frequency of ulcers in this cohort is comparable to other multicenter studies in LMICs, reflecting the burden of advanced disease among patients seeking clinical care.[15] Key risk factors identified included prolonged standing occupation (39.4%), age ≥50 years (42.1%), female sex (46.4%), obesity (23.8%), family history of CVD (25.7%), and low socioeconomic status (30.4%). These findings are consistent with well-established determinants of CVD. Prolonged standing and obesity contribute to venous hypertension and valve incompetence, while advanced age is associated with cumulative valvular damage and reduced calf pump efficiency.[16, 17] Female sex and family history are recognized predisposing factors, likely due to hormonal influences and genetic susceptibility.[18] Socioeconomic disparities may influence disease severity and healthcare-seeking behavior, consistent with findings from other low- and middle-income countries.[19]

In this cohort of 470 participants, the C2 stage (varicose veins) was most frequent (35.1%), followed by the C3 stage (edema, 16.8%) and the C6 stage (active venous ulcer, 9.6%). Early stages (C0–C1) comprised 18.1%, while C4a/b changes (pigmentation, lipodermatosclerosis) affected 13.4%, and C5–C6 (healed/active ulcers) 16.6%. These findings align with global and South Asian data, suggesting that varicose veins are the predominant manifestation, with fewer patients presenting in advanced stages.[1-5] The distribution reflects a progressive gradient of severity, emphasizing that a substantial proportion of patients present with complications requiring clinical management.[20] In this cohort, leg pain (62.8%) and heaviness (59.8%) were the most commonly reported symptoms, aligning with literature that identifies these as primary complaints in CVD.[11] Edema (34.0%) and visible varicosities (35.1%) were also common, reflecting underlying venous reflux and valve incompetence, which are typical pathophysiological features of CVD.[12] Skin changes, including pigmentation or eczema (21.9%), and night cramps (21.7%) were moderately prevalent, while venous ulcers (16.6%) were observed primarily in participants with advanced CEAP stages (C5–C6), aligning with global data that document ulcers in 5–15% of clinic-based populations.[20] These findings underscore the spectrum of clinical manifestations, ranging from mild discomfort to serious complications, highlighting the importance of early recognition and management.

Among the 470 participants, 25.7% reported a family history of CVD, indicating a genetic predisposition.[11] Prolonged standing occupations (39.4%) and obesity (23.8%) were common, reflecting established occupational and lifestyle risk factors that increase venous pressure and valve dysfunction.[3-6] Age ≥50 years (42.1%) aligns with cumulative valvular deterioration and higher disease severity.[21] Female participants (46.4%) highlight sex-related susceptibility, likely influenced by hormonal factors and pregnancy.[11, 12] Additionally, low socioeconomic status (30.4%) may contribute to delayed healthcare access and advanced disease presentation, as observed in LMICs.[10, 11] These findings underscore the multifactorial etiology of CVD, involving genetic, demographic, occupational, lifestyle, and socioeconomic determinants. In this multicenter cohort of 470 participants, C2 stage (varicose veins, 35.1%) was the most prevalent CEAP classification, followed by C3 (edema, 16.8%) and C6 (active ulcers, 9.6%), whereas early stages (C0–C1) accounted for 18.1%. This distribution aligns with global and South Asian studies, indicating that varicose veins remain the predominant manifestation of chronic venous disease (CVD), while advanced stages, although less frequent, contribute substantially to morbidity.[22] Clinical manifestations were dominated by leg pain (62.8%) and heaviness (59.8%), with edema (34.0%), visible varicosities (35.1%), skin changes (21.9%), night cramps (21.7%), and venous ulcers (16.6%), reflecting the full spectrum of CVD severity observed in comparable populations.[11, 12]

Risk factor analysis identified prolonged standing (39.4%), obesity (23.8%), age ≥50 years (42.1%), female sex (46.4%), family history (25.7%), and low socioeconomic status (30.4%) as key contributors to disease onset and progression. Notably, advanced CEAP stages (C5–C6) were more prevalent among obese participants and those with prolonged standing, emphasizing the interplay of lifestyle, occupational, and demographic factors in CVD severity.[7, 20, 23] Advanced CEAP stages (C5–C6) were more frequent among obese individuals and those with prolonged standing, highlighting their impact on severity. Complications escalated with CEAP stage,

from 3.6% in C0 to 77.8% in C6, confirming the progressive nature of CVD and reinforcing the importance of early detection and intervention to prevent ulceration and chronic morbidity.[12] Collectively, these findings highlight the multifactorial etiology and wide clinical spectrum of CVD in Bangladesh, emphasizing the need for preventive strategies, occupational counseling, and targeted management for high-risk groups to reduce disease burden and improve patient outcomes.

Conclusion

This multicenter cross-sectional study demonstrates that chronic venous disease (CVD) in Bangladesh predominantly presents at the C2 stage (varicose veins), with a significant proportion of participants experiencing advanced stages (C5–C6) associated with complications such as venous ulcers. Leg pain, heaviness, edema, and visible varicosities were the most common clinical manifestations, reflecting the broad spectrum of disease severity. Key risk factors identified include prolonged standing, obesity, older age, female sex, family history, and low socioeconomic status, highlighting the multifactorial etiology of CVD. The study further confirms that complications increase progressively with CEAP stage, underscoring the importance of early detection and intervention. These findings emphasize the need for preventive strategies, occupational guidance, and targeted management for high-risk populations to reduce morbidity, improve quality of life, and optimize healthcare resource allocation in Bangladesh.

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