Severity Stages of Chronic Venous Insufficiency: A Study in Kinshasa, DR Congo

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1 Abstract

Objective: To determine the burden and impact of chronic venous insufficiency (CVI) of the lower limbs in Kinshasa, Democratic Republic of Congo (DRC).

Methods: We conducted a retrospective clinical study on a random sample of 393 patients diagnosed with chronic venous disease (CVD) between 2019 and 2024 at an urban hospital in Kinshasa. These patients represented 81% of a larger cohort of 486 individuals who presented with dermatologic disorders of the lower limbs during the period.

Results: Disease severity, per the CEAP clinical classification, indicated that 362 patients (92%) were diagnosed with CVI (classes C3 through C6), most commonly presenting at stage C3 (26.5%, edema) or C6 (44.5%, active venous ulcers). Limb-level disease patterns were as follows: (1) Symmetric Disease: 33% of patients exhibited identical CEAP classes in both lower limbs; (2) Asymmetric Bilateral C6 Involvement: 14% had left-dominant and 10% had right-dominant presentation; (3) Unilateral Involvement: 17% of patients had disease confined to the left limb and 11% to the right limb.

Conclusions: Our observations confirm the significant role of venous pathology in lower limb dermatologic disorders, establishing it as the primary cause of lower limb ulcers, consistent with findings from Western populations. In Kinshasa, and likely in other megacities across sub-Saharan Africa, these data highlight an evolving epidemiological landscape characterized by a dual burden of non-communicable and communicable diseases. At the community level, the vernacular term “MBASU” is indiscriminately applied to a variety of dermatologic conditions, including erythema, papules, unsightly wounds, edema, fibrosis, and both healed and active ulcers. To enhance clarity in clinical management and inform public health policy, we propose the adoption of a locally rooted terminology that distinguishes “Non-infectious MBASU (NIM)” from “Infectious MBASU (IM)”, emphasizing a necessary semantic and conceptual shift.

2 Introduction

Chronic venous insufficiency (CVI) constitutes a significant global health burden, affecting a substantial proportion of the worldwide population. According to the Vein Consult Program, a study involving over 91,000 adults from 23 countries, the overall prevalence of chronic venous disease (CVD) was estimated at **83.6%**. Among these, **32.3%** of patients exhibited signs consistent with CVI, defined as CEAP clinical classes C3 through C6. (1)

In sub-Saharan Africa, and particularly within the Democratic Republic of Congo (DRC), the presentation of CVI is characterized by unique social, epidemiological, and clinical specificities, distinguishing it from manifestations observed in other global regions. Several contributing factors underpin these regional distinctions.

Demographic Context

Sub-Saharan Africa's demographic landscape is undergoing profound transformation. With an estimated population of 1.2 billion in 2022, projections indicate a rise to 2.7 billion within the next half-century, thereby surpassing the populations of both China and India. This trajectory positions the region as the sole global area experiencing sustained growth in its labor market. Over this horizon, the working-age population (15-64 years) in sub-Saharan Africa is projected to constitute a progressively dominant share of the global total, increasing from 12% in 2022 to an estimated 22% by 2050 and 30% by 2075. (2)

Habitat

African megacities are currently undergoing explosive growth. For instance, Kinshasa's population tripled between 2000 and 2024 to 20 million inhabitants, at an annual growth rate of 4.50%. (3) This urban concentration shapes distinct epidemiological profiles related to etiologies s.a. veinous insufficiency, arteriopathy and diabetes, distinct from those observed in rural areas with a focus on infectious pathologies.

Cultural Perception

Dermatological disorders are widely perceived, even among the intellectual elite, as having a mystical etiology. The vernacular term “MBASU,” which translates to 'malevolent sorcery' in the Democratic Republic of Congo, exemplifies this. The management of these conditions frequently involves traditional healers, Indigenous practitioners, or religious leaders, who employ traditional rituals and administer ineffective or inappropriate esoteric remedies. In this context, patients grappling with disabling sequelae often experience profound professional, familial, and psychological difficulties.

Infectious diseases

Traditionally, infectious diseases have been a significant health challenge in many parts of Sub-Saharan Africa, particularly in rural areas. Infectious pathologies, such as Buruli ulcer, are still widely associated with malevolent sorcery and popularization of the subject by modern media has created collective psychosis. (4) (5) (6) Buruli ulcer affects the trunk and all four limbs, and is predominant in adolescents living in rural marshy regions. It is the third mycobacterial disease affecting humans, after leprosy and tuberculosis. It frequently manifests as an initially painless nodule that can evolve into a plaque or diffuse edema on the face, arms, and legs. The disease can progress without pain or fever. In the absence of treatment, or sometimes even during antibiotic therapy, the nodule, plaque, or edema can ulcerate within four weeks. In some cases, bone involvement may occur, resulting in deformities. (7) The number of cases remains however marginal in comparison to other wound etiologies. According to the WHO, the confirmed cases for the DRC (2025 population: 111 million) were: 74 (2023), 84 (2022), 54 (2021), and 111 (2020). (8) (9) In Kinshasa (population: 20 million), 13 positive cases were reported over three years of observation (2016–2018). (10) (11)

Chronic venous insufficiency

Diagnosis is often significantly delayed due to a confluence of factors. The complex interplay between coexisting endemic infectious and emerging non-communicable diseases (NCDs), coupled with the aforementioned socio-demographic challenges, collectively impairs timely and accurate etiological diagnosis, frequently resulting in severe complications such as edema, fibrosis, and active or healed ulcers at advanced stages. Furthermore, effective CVI management necessitates substantial human and material resources, which are inaccessible in regions with limited healthcare infrastructure. This includes, but is not limited to, diagnostic tools like Doppler ultrasound, advanced wound care modalities (e.g., specialized dressings, high-quality compression stockings, pressotherapy, negative pressure therapy), interventional procedures (e.g., foam sclerotherapy, endovenous radiofrequency or glue ablation).

3 Objective

This study addresses the well-established scarcity of clinical data and medical research on CVI in sub-Saharan Africa. (1) By providing clinical examination-based data and analysis, this research will help to objectify the necessary human, financial, and material resources and conditions required for the effective management of CVI.

4 Context

This study was conducted at a hospital in Kinshasa (DRC), which provides a comprehensive care pathway for lower limb wounds. The accompanying images (Figure 1) illustrate the clinical case of a 57-year-old male with post-thrombotic syndrome and **CEAP C3,6 CVI (indicating edema and active ulcer)** secondary to left great and small saphenous vein incompetence. The key stages of this pathway demonstrate wound evolution and the impact of the interventions from admission through post-procedural care, including patient admission, debridement, negative pressure wound therapy (NPWT), minimally invasive radiofrequency ablation (RFA) surgery, grafting, and post-procedural care.

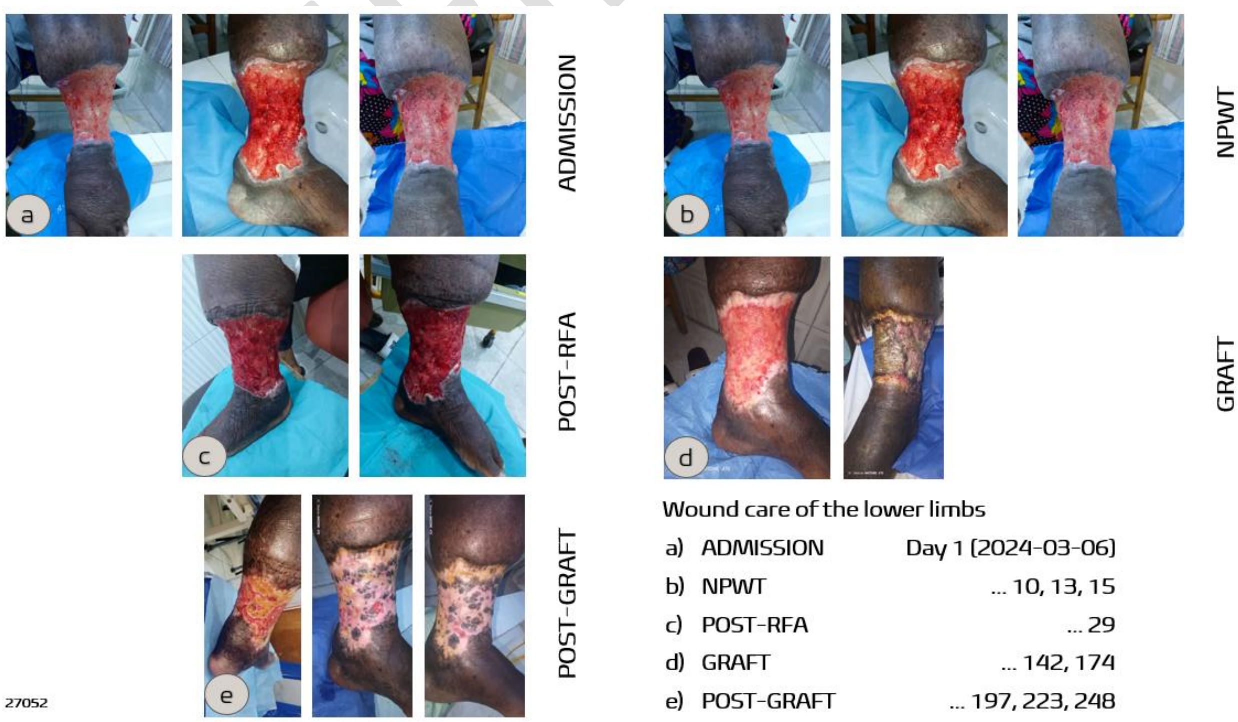

Figure 1

5 Methods

5.1 Study Design

This retrospective observational study aims to analyze chronic venous insufficiency (CVI) in the lower limbs as observed in clinical practice. It is based on data collected between January 2019 and June 2024 from a larger cohort of patients evaluated for dermatologic conditions, locally referred to as “MBASU”. Patients are from Kinshasa and were included in the study based on the following two criteria: (1) **Medical Criteria:** Patients exhibited signs and symptoms of varying severity related to diseases affecting the lower limbs. These conditions included venous disorders, arterial diseases, diabetic complications, cancerous conditions, and infectious diseases. (2) **Financial Criteria:** Except for social cases, patients were financially responsible for the long-term costs associated with general and specialized medical consultations, as well as wound care tailored to their specific condition. For context, a general consultation was billed at 6 USD (2024), while specialized consultations ranged from 20 to 30 USD, depending on the specialty.

All patients were examined by the (lead) author using Doppler ultrasound over the specified period. Patients' clinical severity was classified according to the Clinical, Etiological, Anatomical, Pathophysiological (CEAP) classification system. (12) Briefly, the clinical (C) component grades severity from C0 (no visible or palpable signs of venous disease) to C6 (active venous ulcer). Specific clinical classes include C0: No visible or palpable signs of venous disease; C1: Telangiectasias or reticular veins; C2: Varicose veins; C3: Edema; C4: Skin changes ascribed to venous disease (e.g., pigmentation, eczema, lipodermatosclerosis); C5: Healed venous ulcer; and C6: Active venous ulcer.

The distinction was made between CVD (chronic venous insufficiency; classes C0-C6) and CVI (chronic venous insufficiency; classes C3-C6). Disease severity was defined as either mild (C0 to C2: no visible signs to varicose veins) or severe (C3 to C6: edema to active venous ulceration), thus corresponding to CVI. The CEAP class was assigned per patient based on the highest class of clinical signs identified in either of the lower limbs. For analyses of limb laterality, the highest CEAP value was determined for each limb, and these paired values were compared within patients. To conduct a systematic bilateral limb assessment, we supplemented the CEAP classes with a 'Not Affected' (NA) grade for cases where only one limb was affected.

5.2 Statistical Analysis

1. Etiology: Clinical data characterizing the etiology of dermatological conditions were retrospectively collected from patient medical records over the period. Upon analysis, venous disease emerged as the most prevalent cause, prompting a more detailed examination of the following variables: patient sex, age, disease severity. CEAP (Clinical, Etiological, Anatomical, Pathophysiological) classes were further regrouped by patient age, sex, and limb laterality (right vs. left).

2. Patient sex: The distribution was analyzed using the chisquare goodness of fit. Ratios and effect sizes were computed.

3,4,5. Patient age: Descriptive statistics of age distribution, including the median, Median Absolute Deviation (MAD), and Interquartile Range (IQR), were evaluated using bootstrap resampling methods. Normality of the distributions was assessed separately by sex, bilaterality, and laterality using the Shapiro-Wilk test. Comparisons between groups were performed using non-parametric tests, including the Mann-Whitney U test and the Kolmogorov-Smirnov test. The Fligner–Killeen test was used to assess differences in age dispersion. Normalized cumulative distribution functions were used to evaluate differences in age-related consultation patterns between male and female patients.

6. Disease Severity: The association between disease severity (C0–C2 vs. C3–C6) and sex was assessed using the Fisher's exact test. Additionally, the overall sex distribution (male vs. female) was evaluated against a 50:50 ratio using the binomial test. Relative risks were calculated to quantify associations related to disease severity and sex.

7. CEAP classes by sex: Sex-related CEAP association analyses included a chi-square test of independence, identification of significant adjusted residuals, and quantification of associations using Cramér's V. Considering the ordinal nature of CEAP stages, we compared sex distributions using the Mann-Whitney U test. Additionally, we evaluated each CEAP class stratum using Chi-Squared or Fisher's exact tests ("in class"/ "not in class" vs. sex), a two-proportion z-test to compare male and female frequencies across their respective distributions, and a binomial test for deviation from an equal split. We assessed risk ratios and their 95% confidence intervals. Finally, we used ordinal logistic regression to model CEAP class as a function of sex.

8. CEAP classes by age: The association between CEAP classes and age, treated as a continuous variable, was evaluated using correlation analyses, including Spearman's rank correlation coefficient and Kendall's tau-b. Asymmetric association patterns were assessed using Goodman-Kruskal gamma and Somers' D. Additionally, Theil's uncertainty coefficients were used to quantify the predictive association between the variables. Finally, we used ordinal logistic regression to model CEAP class as a function of age.

9. CEAP classes by laterality: Laterality-related CEAP evaluations utilized paired statistical methods, including the Stuart-Maxwell and Bowker tests for assessing overall marginal homogeneity and symmetry, the Wilcoxon signed-rank test, and the McNemar test for evaluating marginal homogeneity within CEAP categories. Disease patterns were further characterized using cross-tabulations of paired limb-specific CEAP classifications.

10. CEAP classes by sex, age, laterality as predictors (using CLMM, CLM, ordinal GEE, binary GEE): To evaluate how age, sex, and limb side predict clinical signs, we fitted several ordinal logistic regression models: (1) A Cumulative Link Mixed Model (CLMM) with random intercepts for patient ID to account for within-subject correlation due to multiple limbs per patient; (2) A Cumulative Link Model (CLM) with fixed effects to simplify inference on covariates such as age, sex, and limb side; and (3) The ordinal variant of the Generalized Estimating Equations (GEE) model for analyzing population-averaged effects while accounting for within-cluster correlation. For a CEAP stratum-wise regression analysis, the binary GEE model variant was employed. To account for cases of unilateral limb disease, the CEAP classification was supplemented with the 'NA' (Not Affected) class.

11. CEAP analysis subject to multiple testing adjustments: These consisted of applying Bonferroni and False Discovery Rate (FDR) corrections for statistical tests iterating through the 7 CEAP classes, supplemented with the 'NA' value.

12. Patient treatment: A basic summary report was produced.

5.3 Tools

All analyses were performed using statistical libraries either in Python 3.11 or R 4.5.1. Statistical significance was assessed at a threshold of $p < .05$, and confidence intervals (CIs) were calculated at the 95% level, using the Wilson method by default. Bootstrap resampling was conducted with a default of 10,000 iterations. For multiple testing correction in the context of iterative CEAP analyses, the nominal p-value of .05 was adjusted to a Bonferroni-corrected threshold of .00625 (.05/8), and to .01875 (.05/8*3) using the False Discovery Rate (FDR) method.

6 Results

6.1 Tables

Table 1	Etiology of dermatologic disorder in lower limbs		
	Pathology	%	Patients
	Venous	81%	393
	Arterial	5%	26
	Mixed	2%	8
	Diabetic	9%	45
	Cancerous	3%	14
	Total		486

Table 2	Age by sex (patient-level)										
		10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	Total
	M	3	7	12	27	43	39	31	6	0	168
	F	2	8	25	35	49	53	41	11	1	225
	Total	5	15	37	62	92	92	72	17	1	393

Table 3	Age by bilaterality (patient-level)										
		10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	Total
	U	3	6	8	25	24	18	18	8	0	110
	B	2	9	29	37	68	74	54	9	1	283
	Total	5	15	37	62	92	92	72	17	1	393

Table 4	Age by laterality (patient-level)										
		10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	Total
	R	0	5	1	9	7	10	8	3	0	43
	L	3	1	7	16	17	8	10	5	0	67
	Total	3	6	8	25	24	18	18	8	0	110

Table 5	Disease Severity (patient-level)			
	Sex	Severity		
		C0..C2	C3..C6	Total
	M	12	156	168
	F	19	206	225
	Total	31	362	393

Table 6.1	CEAP classes by sex (patient-level)							
Sex	CEAP							
	C0	C1	C2	C3	C4	C5	C6	Total
M	0	3	9	35	20	13	88	168
F	1	3	15	69	31	19	87	225
Total	1	6	24	104	51	32	175	393

Table 6.2	CEAP classes by sex, cumulative percentages (patient-level)						
Sex	CEAP						
	C0	C1	C2	C3	C4	C5	C6
M	100.0	100.0	98.2	92.9	72.0	60.1	52.4
F	100.0	99.6	98.2	91.6	60.9	47.1	38.7
Total	100.0	99.7	98.2	92.1	65.6	52.7	44.5

Table 7	CEAP classes by age (patient-level)															
Age	CEAP															
	C0		C1		C2		C3		C4		C5		C6		Total	
	abs	pct	abs	pct	abs	pct	abs	pct	abs	pct	abs	pct	abs	pct	abs	pct
10-19	0	0.0	0	0.0	0	0.0	3	3.0	0	0.0	1	1.0	1	1.0	5	5.0
20-29	0	0.0	1	1.0	1	1.0	4	4.0	3	3.0	0	0.0	6	6.0	15	15.0
30-39	0	0.0	0	0.0	4	4.0	9	9.0	4	4.0	1	1.0	19	19.0	37	37.0
40-49	0	0.0	1	1.0	3	3.0	15	15.0	8	8.0	5	5.0	30	30.0	62	62.0
50-59	0	0.0	0	0.0	5	5.0	29	29.0	6	6.0	7	7.0	45	45.0	92	92.0
60-69	1	1.0	1	1.0	9	9.0	20	20.0	21	21.0	10	10.0	30	30.0	92	92.0
70-79	0	0.0	3	3.0	2	2.0	20	20.0	7	7.0	7	7.0	33	33.0	72	72.0
80-89	0	0.0	0	0.0	0	0.0	4	4.0	2	2.0	1	1.0	10	10.0	17	17.0
90-99	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.0	1	1.0
Total	1	0.3	6	1.5	24	6.1	104	26.5	51	13.0	32	8.1	175	44.5	393	100.0

Table 8.1 CEAP classes by laterality (limb-level)

Limb	CEAP								
	NA	C0	C1	C2	C3	C4	C5	C6	Total
R	67	4	10	66	98	41	24	83	393
L	43	3	9	48	101	47	29	113	393
Total	110	7	19	114	199	88	53	196	786

Table 8.2 CEAP classes by laterality, cumulative percentages (limb-level)

Limb	CEAP							
	NA	C0	C1	C2	C3	C4	C5	C6
R	100.0	83.0	81.9	79.4	62.6	37.7	27.2	21.1
L	100.0	89.1	88.3	86.0	73.8	48.1	36.1	28.8
Total	100.0	86.0	85.1	82.7	68.2	42.9	31.7	24.9

Table 9 CEAP class pairs by laterality (limb-level)

ceap_R	ceap_L								
	NA	C0	C1	C2	C3	C4	C5	C6	Total
C6	21	1	0	17	11	4	8	21	83
C5	0	0	1	2	2	6	6	7	24
C4	3	1	2	2	6	21	1	5	41
C3	13	0	2	7	60	7	2	7	98
C2	3	1	0	17	8	2	4	31	66
C1	2	0	3	0	0	1	1	3	10
C0	1	0	0	1	0	1	0	1	4
NA	0	0	1	2	14	5	7	38	67
Total	43	3	9	48	101	47	29	113	393

Table 10 CEAP class pairs by laterality by sex (limb-level)

Disease schema	Pattern	All		Males		Females	
Bilateral symmetric	Diagonal	128	33%	42	25%	86	38%
Bilateral C6 right	C6_right	41	10%	18	11%	23	10%
Bilateral C6 left	C6_left	54	14%	26	15%	28	12%
Unilateral left	NA_right	67	17%	34	20%	33	15%
Unilateral right	NA_left	43	11%	21	13%	22	10%
Remainder	Other	60	15%	27	16%	33	15%
	Total	393	100%	168	100%	225	100%

Table 11 CEAP class by sex, age, laterality

Logistic regression without limb clustering (CLM)

Variable	Estimate	Std. Error	z value	Pr(>|z|)	Estimate	OR	Lower 95%CI	Upper 95%CI
age	0.007	0.004	1.573	0.116	0.007	1.007	0.998	1.015
sexM	0.010	0.129	0.075	0.940	0.01	1.01	0.784	1.3
lateralityR	-0.452	0.127	-3.557	0.000	-0.452	0.637	0.496	0.816
NA|C0	-1.688	0.269	-6.283	The right limb has 36.3% lower odds of being in a higher CEAP class				
C0|C1	-1.615	0.268	-6.035	compared to the left limb (OR=0.637; 95% CI: 0.50–0.82; p<0.001).				
C1|C2	-1.435	0.266	-5.404	This difference is statistically significant.				
C2|C3	-0.623	0.260	-2.396					
C3|C4	0.445	0.260	1.709					
C4|C5	0.933	0.262	3.558					
C5|C6	1.270	0.264	4.810					

McFadden pseudo R^2 0.0055

6.2 Figures

Figure 2

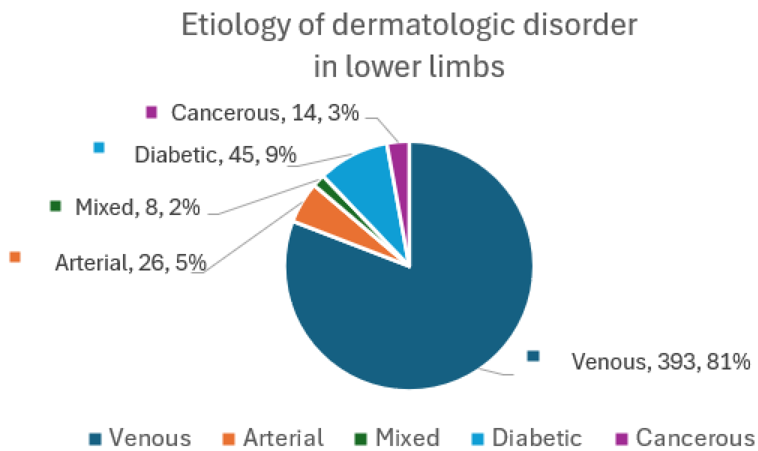

Figure 3

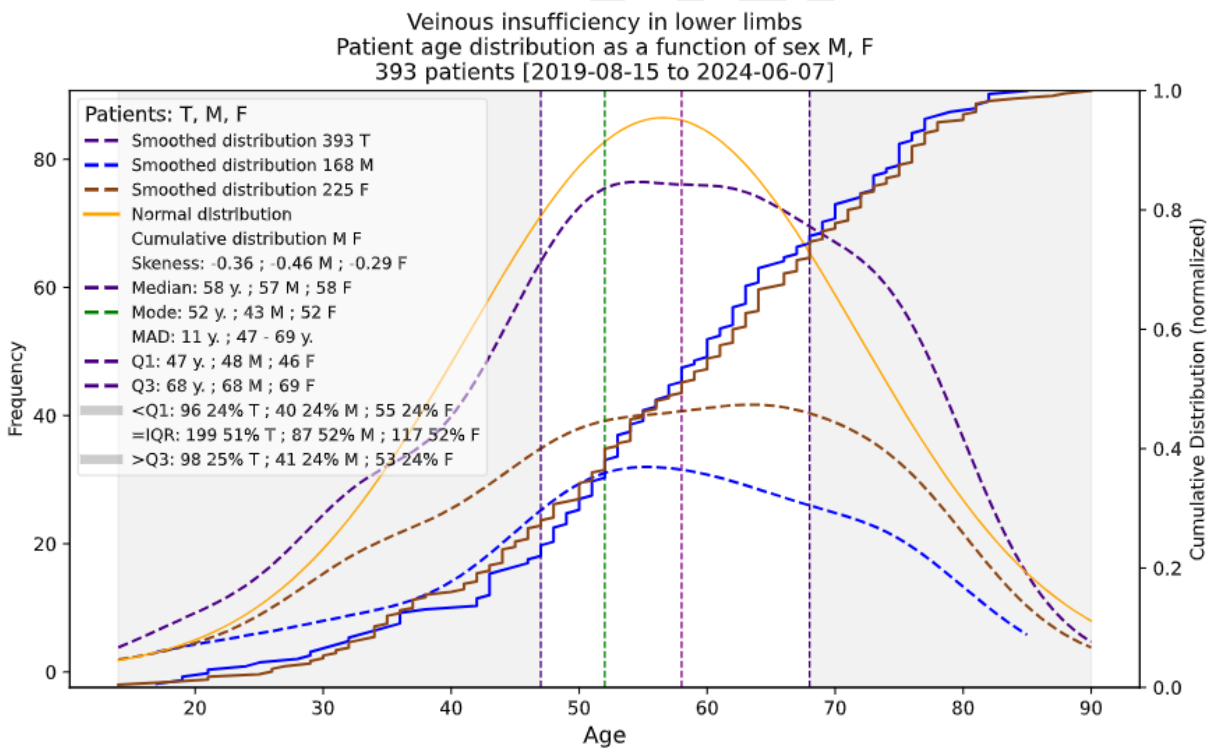

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Figure 4

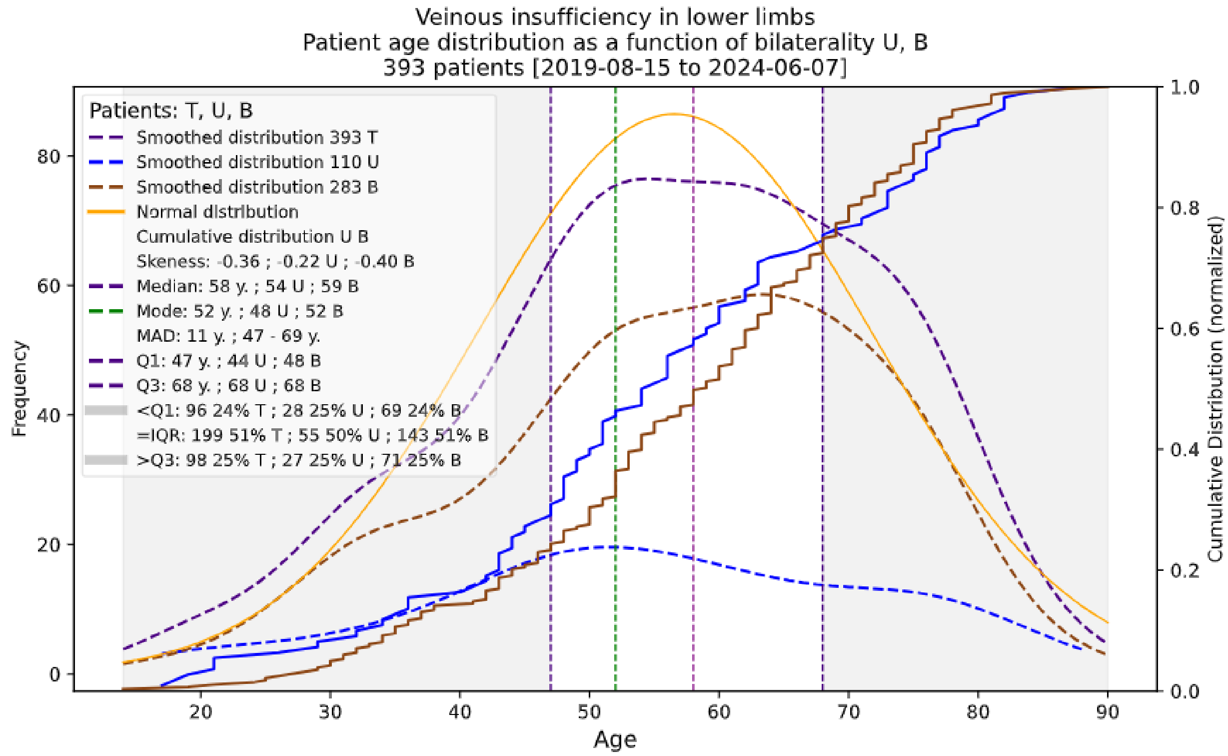

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Figure 5

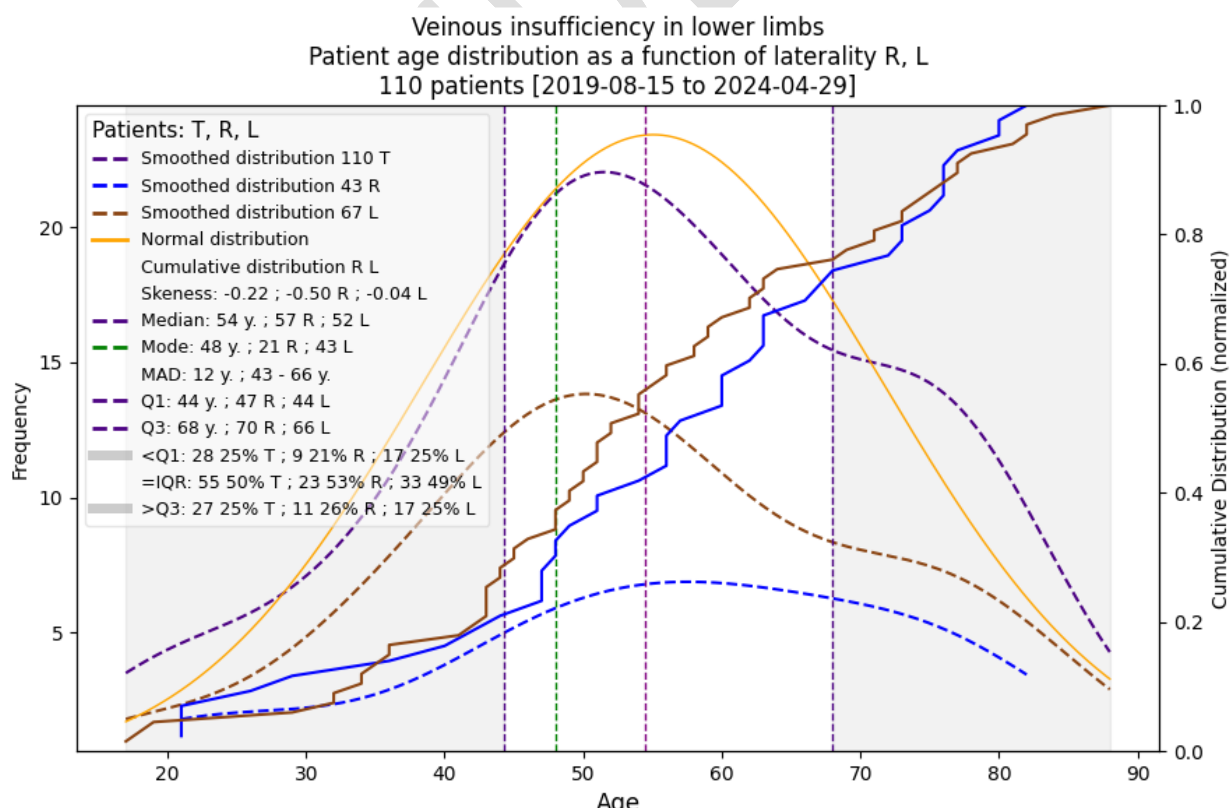

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Figure 6

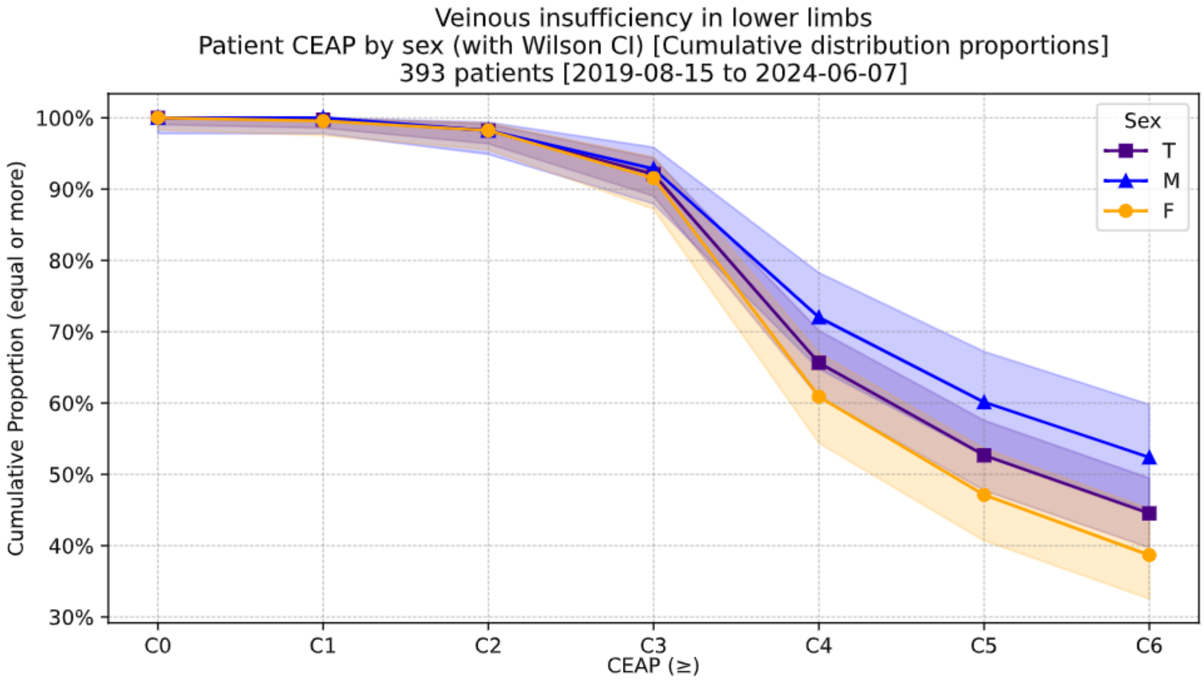

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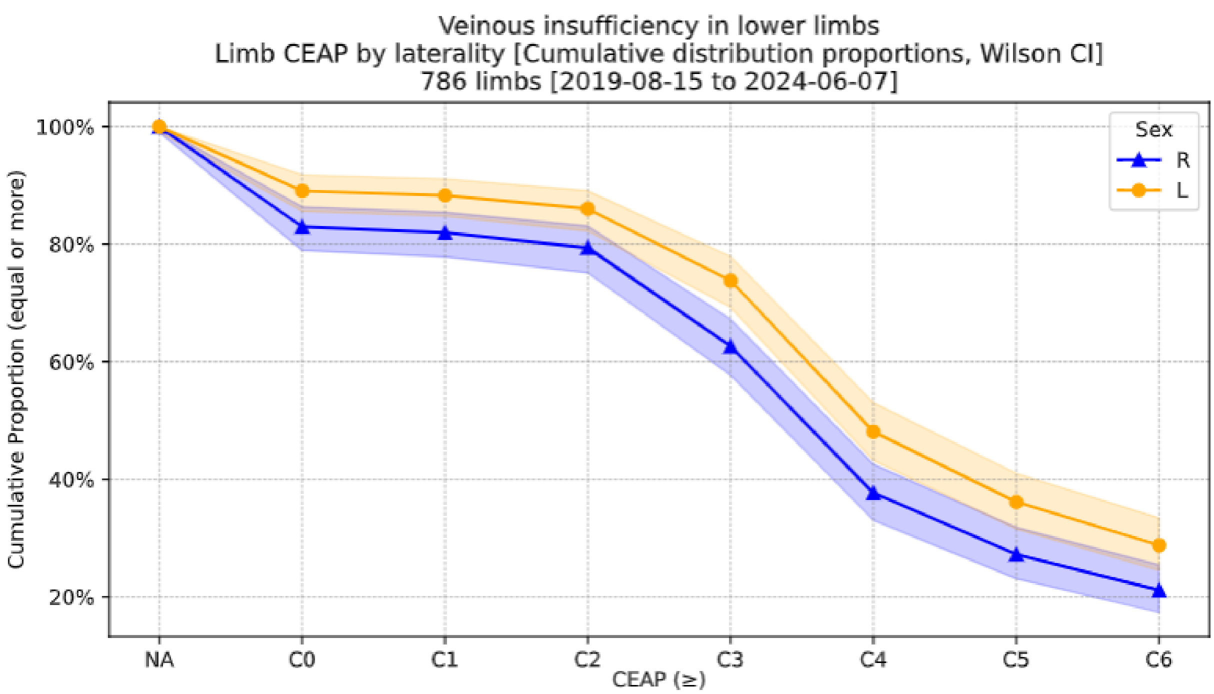
Figure 7



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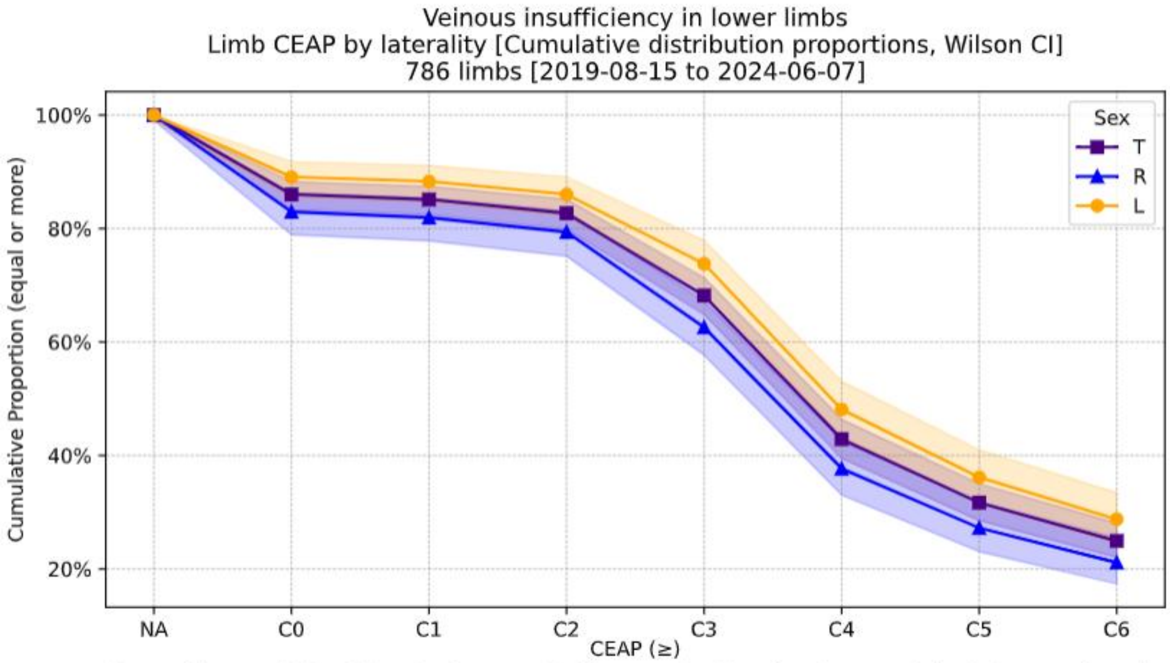

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Figure 8

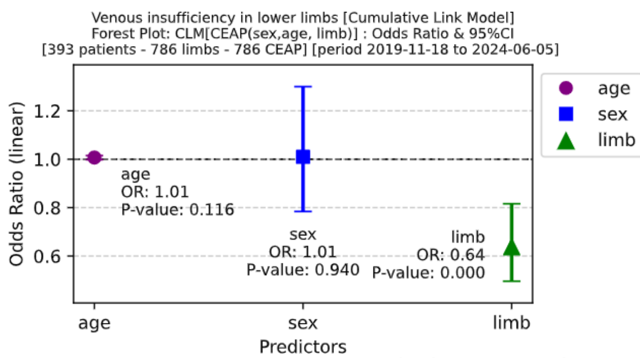

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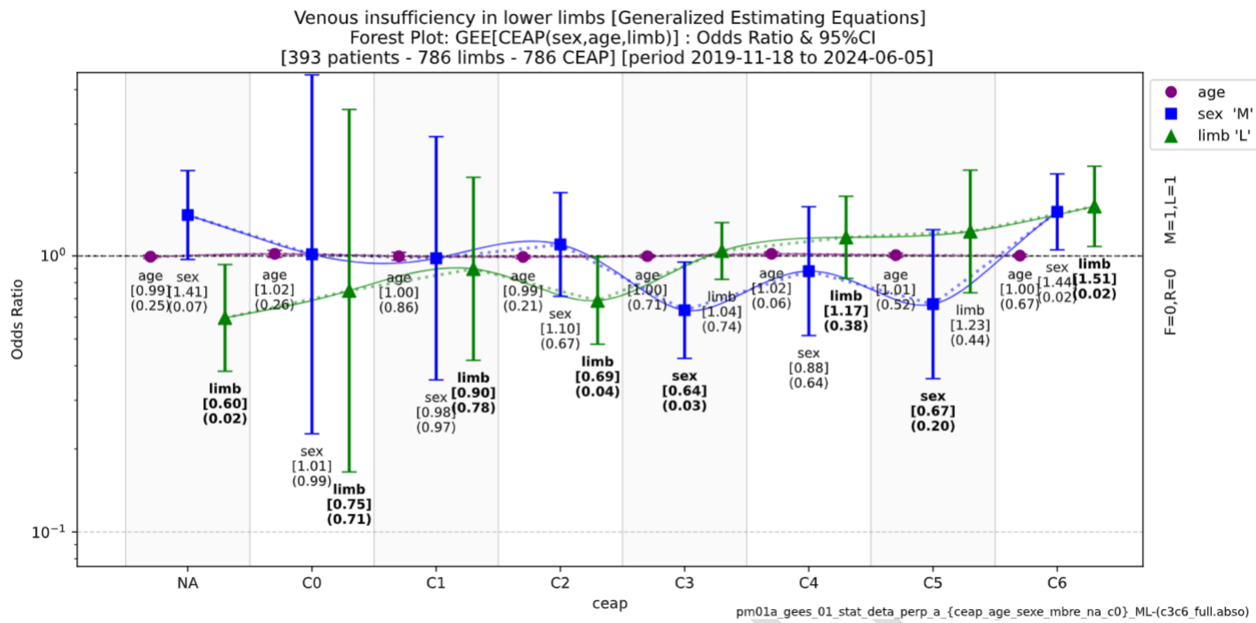
Figure 9



6.3 Presentation

6.3.1 Etiology (table 1, figure 2)

The venous cohort, consisting of 393 patients, was drawn from a population of 486 patients who were examined for disorders in their lower limbs. **Pathologies of venous vascular (80%)**, **arterial (6%)**, **mixed (2%)**, as well as **diabetic without venous involvement (10%)**, and **cancerous (3%) origin** were diagnosed. No infectious causes were identified.

6.3.2 Patient sex (table 5)

The cohort comprised 168 men (42.7%) and 225 women (57.3%), resulting in a female-to-male ratio of 1.34:1. A chi-square goodness-of-fit test indicated a significant deviation from an equal distribution ($\chi^2 = 8.27$, $p = .004$). The effect size was small (Cohen's h = 0.146).

6.3.3 **Patient age by sex** (table 2, figure 3)

The continuous age distributions of male and female patients were closely aligned. Both groups had nearly identical median ages, with men at 57 years and women at 58 years. Women showed only slightly greater variability in age (MAD = 12 years) compared to men (MAD = 10 years). The confidence intervals for the median, Median Absolute Deviation (MAD), and Interquartile Range (IQR) largely overlapped, indicating strong similarities between the two groups. Non-normal distributions were confirmed for both sexes using the Shapiro-Wilk test ($p < 0.01$). The Mann-Whitney U test (U = 18,729, $p = .878$, rank-biserial correlation = -0.005, 95% CI [-0.108, 0.124]) revealed no significant difference in the ranking of ages between the sexes, while the Kolmogorov-Smirnov test (D = 0.052, $p = .938$) found no significant difference in their overall age distributions. Fligner–Killeen test found no significant difference in age dispersion ($\chi^2 = 1.050$, $p = .305$). Levene and Ansari–Bradley tests confirmed this result. **Beyond these similarities**, the absolute frequency of female patients exceeded that of male patients across all ages. More subtle, yet notable, differences existed between the age distributions. Regarding kurtosis, females exhibited a more pronounced platykurtic value (-

0.57 vs. -0.21), meaning their age distribution was more spread out and less peaked compared to that of males. In terms of skewness, males exhibited slightly higher negative skewness (–0.46 vs. –0.29), indicating a greater relative concentration of older individuals among male patients. The normalized cumulative distribution functions revealed that **women tended to consult at an earlier age compared to men**, with notable peaks of divergence at 46 years for women and 64 years for men. The crossover point, where cumulative consultation rates between women and men equalize, occurred at 55 years.

6.3.4 Patient age by bilaterality (table 3, figure 4)

The continuous age distributions of patients with unilateral and bilateral disease were generally aligned. The median age was slightly lower in unilateral cases (54 years) compared to bilateral cases (59 years). Age variability was marginally greater in the unilateral group (MAD = 12 years) than in the bilateral group (MAD = 10 years). The confidence intervals for the median, Median Absolute Deviation (MAD), and Interquartile Range (IQR) largely overlapped, indicating strong similarities between the two groups. The Shapiro-Wilk test confirmed a non-normal distribution for the bilateral group and marginally rejected the normality hypothesis for the unilateral group (p = 0.067). The Mann-Whitney U test (U = 14,337, p = .225, rank-biserial correlation = –0.039, 95% CI [–0.050, 0.208]) revealed no significant difference and the Kolmogorov-Smirnov test (D = 0.127, p = .138) both supported the conclusion that unilateral and bilateral patients were age-matched. Fligner–Killeen test found no significant difference in age dispersion (χ^2 = 2.123, p = .145). Levene and Ansari–Bradley tests confirmed this result. **Beyond these similarities**, the absolute frequency of bilateral patients exceeded that of unilateral patients across all ages. Subtle, yet notable, differences existed between the age distributions. Regarding kurtosis, unilateral cases exhibited a more pronounced platykurtic value (-0.52) compared to bilateral cases (-0.42). In terms of skewness, bilateral cases showed a higher negative skewness (-0.40) compared to unilateral cases (-0.22). The normalized cumulative distribution functions indicated that **patients tended to present with unilateral cases earlier than bilateral cases up to age 70, after which the trend reverses**. There were notable peaks of divergence at 52 years for unilateral cases and at 75 years for bilateral cases.

6.3.5 Patient age by laterality (table 4, figure 5)

The continuous age distributions of unilateral patients with either right- or left-sided disease were closely aligned. Median ages were 57 years for right-sided and 52 years for left-sided cases. Variability in age was comparable between groups, with a median absolute deviation (MAD) of 10 years in both. The confidence intervals for the median, MAD, and interquartile range (IQR) exhibited substantial overlap, suggesting significant similarities between the two cohorts. The Shapiro-Wilk test indicated a non-normal distribution for the left-sided presentation and a near-normal one for the right-sided presentation (p = .053). The Mann-Whitney U test (U = 1,578, p = .399, rank-biserial correlation = 0.048, 95% CI [−0.312, 0.130]) and the Kolmogorov-Smirnov test (D = 0.149, p = .547) confirmed age distributions were not significantly different. Fligner–Killeen test found no significant difference in age dispersion (χ^2 = 0.045, p = .832). Levene and Ansari–Bradley tests confirmed this result. **Beyond these similarities**, the absolute frequency of left-sided cases exceeded that of right-sided cases across all ages. Subtle yet notable differences were also observed in their age distributions. In terms of skewness, right-sided cases demonstrated a more pronounced age distribution skewed toward younger patients, with a higher degree of negative skewness (−0. 50) compared to left-sided cases (−0. 04). However, the overall shape of the distributions was similar, as reflected by comparable kurtosis values for the right (−0.48) and left limb sides (−0.46). Normalized cumulative distribution functions further revealed **a consistently higher cumulative proportion of younger patients with left-sided disease between ages 29 and 75**, with the greatest divergence occurring around age 56.

6.3.6 Disease severity (table 5)

Among the 393 patients assessed, the majority (n = 362; 92.1%) presented with severe disease (CVI, C3–C6), while only 31 patients had mild disease (C0–C2). Of those with CVI, 156 (43%) were male and 206 (57%) were female. Within the mild disease group, 12 (39%) were male and 19 (61%) were female. There was **no statistically significant association between sex and disease severity** (Fisher's exact test odds ratio = 0.834, p = .708). The risk of severe disease was slightly lower in males than females, with a risk ratio of 0.85 (95% CI [0.42, 1.69]). The magnitude of association was negligible (Cramer's V = 0.014), indicating no meaningful sex-based difference in disease severity. Additionally, exact binomial tests performed separately within severity groups revealed a statistically significant **overrepresentation of females in the severe disease category** (statistic = 0.569, p = .010).

6.3.7 CEAP classes by sex (tables 6.1, 6.2, figure 6)

A descriptive analysis revealed **a bimodal distribution of CEAP stages, with peaks at C3 (edema; 104 patients, 26.5%) and C6 (active ulcers; 175 patients, 44.5%).** Together, these two stages accounted for 71% of the total study population.

Male patients presented with 20.8% of cases at the C3 stage and 52.4% at the C6 stage, whereas female patients presented with 30.7% of cases at C3 and 38.7% at C6. These findings were further supported by a high median CEAP stage of C6 (MAD = 0.0) among males, indicating strong clustering at the most severe class. In contrast, females showed a lower median severity (C4) and slightly greater variability (MAD = 1.0), reflecting the combined weight of cases at both C3 and C6. Overall dispersion of CEAP stages was modest in both groups, with an interquartile range (IQR) of 3.0. The most frequent stage (mode) was C6 in both sexes.

A distribution-wide analysis revealed the following findings. A chi-square test of independence indicated no statistically significant association between sex and CEAP classification when categories were treated nominally (χ^2 = 9.042, p = .171). The effect size, measured by Cramér's V (0.152), suggests a small association. Examination of the adjusted residuals showed that females had a significantly higher-than-expected frequency in CEAP class C3 (adjusted residual = 2.19), whereas males exhibited a notable excess in C6 cases (adjusted residual = 2.71). However, since the overall chi-square test was not statistically significant, these findings should be interpreted with caution.

A Mann–Whitney U test showed a statistically significant difference in CEAP grades favoring higher values among male patients (U = 21,696; p = .008), corresponding to a 14.79% shift from the median. The rank-biserial correlation indicated a small effect size (r = 0.127). Furthermore, the common language effect size (Vargha–Delaney A) revealed that a randomly selected male patient had a 57.4% probability (95% CI: 0.521–0.627) of having a higher CEAP grade than a randomly selected female patient.

Stratum-wise analysis of the CEAP distributions reinforced the observations from the descriptive analysis. For CEAP categories C0, C1, C2, C4, and C5, no significant sex differences were identified across any of the statistical tests, indicating proportional sex representation within these categories and relative to the overall population. However, significant differences emerged in the C3 and C6 strata.

In the C3 category, 69 of 225 females (30.7%) were affected, compared to 35 of 168 males (20.8%). This difference was statistically significant, as demonstrated by several tests: the chi-square test (χ^2 = 4.287, p = .038; Cohen's w = 0.104, indicating a small effect size), the two-proportion z-test (z = –2.186, p = .029; 95%

CI: –0.180 to –0.010), and the binomial test ($p = .001$). The risk ratio for females compared to males was 1.47 (95% CI: 1.03–2.10), indicating **a 47% higher likelihood of C3 classification among female patients**.

In the C6 category, 88 of 168 males (52.4%) were affected, compared to 87 of 225 females (38.7%). This difference was statistically significant, as shown by the chi-square test ($\chi^2 = 6.779$, $p = .009$; Cohen's $w = 0.131$, small effect size) and the two-proportion z-test ($z = 2.706$, $p = .007$; 95% CI: 0.038 to 0.234). The risk ratio for males versus females was 1.36 (95% CI: 1.09–1.69), indicating **a 36% higher likelihood of C6 classification among males**. However, the absolute counts were nearly equal, and the binomial test was not significant ($p = 1.0$).

Finally, **ordinal logistic regression** results by threshold were not retained due to violation of the proportional odds assumption, indicating that the effect of sex on CEAP severity differs across CEAP stages.

6.3.8 CEAP classes by age (table 7)

Descriptive analysis using 10-year age bins revealed that **patients categorized in classes C3 through C6 were predominantly concentrated within a narrow age range, specifically in their 50s and 60s.** Among these, male patients had a median age of 57 years (MAD = 10), while female patients had a slightly higher median age of 58 years (MAD = 12), indicating similar central tendencies but modestly greater age variability among females. Within the 30 to 79-year age range, female C3 cases peaked in the 50–59 age bin, while their C6 cases showed a steady increase across the age groups. Conversely, male C3 cases increased steadily with age, and their C6 cases peaked in the 50–59 age bin.

CEAP and continuous age demonstrated a negligible association across all analytical approaches. The absence of a **monotonic relationship** was confirmed by Spearman's rank correlation, which yielded a coefficient (ρ) of 0.011 ($p = .835$), and Kendall's tau, which produced a coefficient (τ) of 0.008 ($p = .832$). **Asymmetric ordinal associations** were also absent: Somers' D for CEAP conditioned on age was 0.007 ($p = .832$), and in the reverse direction, 0.010 ($p = .832$). Goodman-Kruskal's gamma corroborated these findings, showing $\gamma = 0.010$ ($p = .992$, $SE = 1.000$, $Z = 0.010$). **Information-theoretic association** measures based on Theil's entropy indicated that knowledge of age reduced uncertainty in CEAP classification by 9% (using continuous age, with a potential for overfitting) and by 7% (using optimally 15–20 age bins). Conversely, knowledge of the CEAP classification reduced uncertainty about age by 26% (continuous age) and by 4% (binned age).

A sex-stratified analysis of CEAP-age associations yielded further nuanced insights. **For females, the results closely mirrored those of the overall cohort**, showing no statistically significant relationship between age and CEAP classification. Spearman's ρ was 0.104 ($p = 0.118$), Kendall's τ was 0.080 ($p = 0.113$), and Somers' D values were similarly low (CEAP|age = 0.069; age|CEAP = 0.093; both $p = 0.111$). Goodman–Kruskal's gamma was 0.094 ($p = 0.924$), and Theil's uncertainty coefficients were $U(\text{CEAP}|\text{age}) = 0.410$ and $U(\text{age}|\text{CEAP}) = 0.583$, consistent with a weak, non-significant association.

By contrast, the **male subgroup** showed a slightly stronger but still non-significant negative association between CEAP stage and age. Spearman's ρ was –0.138 ($p = 0.075$), and Kendall's τ was –0.109 ($p = 0.066$), suggesting **a slight, non-significant trend toward lower age with increasing severity**. Supporting this, Somers' D was negative in both directions (CEAP|age = –0.089; age|CEAP = –0.132; both $p = 0.075$), and Theil's uncertainty coefficients were slightly higher ($U(\text{CEAP}|\text{age}) = 0.419$; $U(\text{age}|\text{CEAP}) = 0.627$). Goodman–Kruskal's gamma was –0.135 ($p = 0.892$), again indicating insufficient statistical evidence despite directional consistency. This mild inverse relationship in males was driven primarily by the disproportionately high frequency of C6 classification in younger male patients. Specifically, of the 168 male patients, 88 (52%) were classified as C6, with a median age of just 54 years, which is notably younger than the median ages observed in males across other CEAP stages: C1 = 71 years, C2 = 57, C3 = 62, C4 = 62, and C5 = 64.

Finally, **ordinal logistic regression** analyses demonstrated consistent coefficient estimates for age across CEAP categories, with no statistically significant differences at any threshold. Correspondingly, the ordinal logistic regression model confirmed that age was not a significant predictor of disease severity (coefficient = 0.0032, p = .593), indicating no meaningful association between patient age and CEAP classification.

6.3.9 **CEAP classes by laterality** (tables 8, 9, 10, figure 7)

Symmetry and Asymmetry Testing: (1) Contingency table analysis of right-versus-left CEAP classes did not demonstrate significant overall asymmetry (Stuart-Maxwell test: p = 0.128; Bowker test: p = .226). **(2) Cumulative CEAP distributions** by laterality revealed a consistent predominance of higher severity on the left side, with disjoint Wilson confidence intervals observed for all CEAP grades. **(3) The Wilcoxon signed-rank test** further confirmed this lateralization (observed statistic = 28,486.5; p = .006). This is substantially lower than the expected value adjusted for ties (34,582.5) and the simulated mean under equilibrium (37,642.4; SD = 290.7; z-score = -31.5), indicating that when a difference exists, the left limb is more often and more severely affected.

Subgroup and Class-Based Asymmetry: McNemar's test identified specific laterality asymmetries: NA class: Right limb only = 67, Left limb only = 43 (p = .028)); C6 class: Right limb only = 62, Left limb only = 92 (p = .019); C2 class: Right limb only = 49, Left limb only = 31 (p = .057; marginal significance); on sex stratification, the C6 class among males showed significant asymmetry (right limb only = 30, left limb only = 49; p = .043).

A cross-tabulation of limb-related paired CEAP classifications was conducted to characterize the patterns of CVD among patients, comparing left and right lower limb findings per individual: **(1) Symmetric Disease:** 33% of patients exhibited identical CEAP classes in both lower limbs; **(2) Asymmetric Bilateral C6 Involvement**: C6 grade involvement was found asymmetrically, affecting 14% of patients on the left side and 10% on the right side; **(3) Unilateral Involvement**: 17% of patients demonstrated unilateral disease in the left limb, while 11% were affected unilaterally on the right limb; (4) **Other Patterns**: The remaining 15% of patients had CEAP pairings distributed across other combinations. Stratified by sex, females demonstrated a higher rate of bilateral concordance (38%) compared to males (25%).

6.3.10 CEAP classes by sex, age, laterality as predictors (table 11, figures 8, 9)

In our evaluation of the association between CEAP classes and patient characteristics a Cumulative Link Mixed Model (CLMM) was applied using the formula ceap ~ sex + age + laterality + (1 | patient). This model revealed negligible variance for the random effect, resulting in numerical instability.

Subsequently, a Cumulative Link Model (CLM) was employed, yielding stable parameter estimates and standard errors, particularly highlighting improved stability compared to the univariate test for sex. The analysis indicated that only laterality, and not age or sex, was a significant predictor for CEAP classes. Specifically, patients with right limb involvement exhibited 36.3% lower odds of being classified into higher CEAP class compared to those with left limb involvement (OR=0.637; 95% CI: 0.50–0.82; p<0.001). The overall model fit, as measured by McFadden's pseudo R^2, was negligible at 0.55%. Furthermore, relaxing the proportional odds assumption for each predictor did not improve the model fit, since the AIC value remained stable.

Finally, stratum-wise CEAP binary GEE analysis revealed the following predictor effects: (1) Age: is not significantly associated with any outcome of CEAP ; (2) Sex: males have a 36% lower odds (OR = 0.636, 0.425–0.950, p = .027) of presenting with C3 disease than women as well as a 44% higher odds (OR = 1.443, 1.051–1.982, p = .023) of having CEAP class C6 compared to women (3) Laterality: left limb is associated with a 40% reduction in odds of having venous disease (NA) compared to the right limb (OR = 0.596, 0.382–0.931, p = .023), a 31% reduction in odds of having CEAP class C2 (OR = 0.689, 0.479–0.991, p = .045) and a 51% increase in odds of having CEAP class C6 (OR = 1.511, 1.081–2.112, p = .016).

6.3.11 CEAP analysis subject to multiple testing adjustments

Across all iterative, stratum-based CEAP class analyses, we examined associations between clinical sign class and the variables sex, age, and laterality. After applying Bonferroni or False Discovery Rate (FDR) corrections, no results remained statistically significant. The only borderline findings were observed for limb laterality in the NA (p = .113), C2 (p = .153), and C6 (p = .113) classes, where p-values approached significance using the FDR method.

6.3.12 Patient treatment

All patients benefited from nursing care, tailored to their follow-up compliance and financial capacity. Where appropriate, our procedures included the use of compression stockings and advanced wound-healing techniques, such as specialized dressings and negative pressure wound therapy. Radiofrequency ablation (RFA) surgery was performed on 90 out of the 362 severely diseased patients (25%). Additionally, two patients underwent further treatment for recurrence involving the small saphenous veins.

7 Key Findings

1. Etiology: Our analysis of a cohort of 486 patients presenting with lower limb dermatologic disorders upon clinical examination revealed a high prevalence (80%) of vascular venous etiology.

2. Patient sex: The cohort of 393 venous patients included 225 females and 168 males, resulting in a female-to-male sex ratio of 1.34:1. This highlights a higher burden of chronic venous disease (CVD) among women in this population, consistent with trends reported in other studies, such as the Bonn study. (13)

3. Patient age by sex: Although the overall age distribution was broadly similar between sexes, females tended to present at younger ages (below 55 years, with the greatest divergence around 46 years), whereas males predominated among older patients (above 55 years, with the greatest divergence around 64 years).

4. Patient age by bilaterality: Although bilateral involvement was more frequent overall, it became increasingly common after age 70. Notable peaks of divergence were observed around age 52 for unilateral cases and around age 75 for bilateral cases.

5. Patient age by laterality: Left-sided cases were consistently more frequent than right-sided cases across all ages and represented a higher proportion than unilateral cases up to age 70.

6. Disease severity: The findings underscored the high burden of CVI in this population, with patient-level grades C3 to C6 accounting for 92% of cases. Females were significantly overrepresented in the severe disease category.

7. CEAP classes by sex: Although the overall distribution of CEAP classes was broadly similar between sexes, males were more likely to present with advanced ulcerative disease (C6), whereas females were more evenly distributed between the C3 (edema) and C6 stages.

8. CEAP classes by age: This cohort exhibited a negligible association between CEAP class and patient age. Female age distribution closely mirrored that of the overall cohort. However, among males, a slight negative association between age and clinical severity was observed, driven by their overrepresentation in the C6 stage, which was associated with a younger median age (54 years) compared to males in other CEAP classes.

9. CEAP classes by laterality: Limb-level analysis of CEAP classes demonstrated a consistent predominance of higher disease severity on the left side. In addition, the study revealed streamlined disease patterns in 85% of cases. Symmetrical limb severity was observed in 33% of cases. Among patients exhibiting asymmetrical presentations (52% of cases), there was a marked predominance and greater severity of chronic venous disease in the left lower limb (31% versus 21% for the right). When stratified by sex, a higher proportion of females exhibited bilateral concordance (38%) compared to males (25%).

10. CEAP classes by sex, age, laterality as predictors: Logistic regression methods contextualized the individual results produced by classical analysis using univariate assessments. Age showed no significant association with CEAP disease severity in this cohort. The effect of sex varied by CEAP grade: males were overrepresented in unilateral cases (NA), underrepresented in moderate disease (C3), and overrepresented in severe disease (C6). Laterality emerged as a consistent predictor of CEAP severity, with a shift in preponderance from the right limb in unilateral cases toward the left limb in severe cases (C6). Although statistically significant associations exist, the models explained only a small proportion of the variance in disease severity.

11. CEAP analysis subject to multiple testing adjustments: Stratified analyses examining the associations between individual CEAP classes and the variables age, sex, and laterality did not retain statistical significance after applying False Discovery Rate (FDR) correction for multiple comparisons. However, in the McNemar test evaluating paired limb laterality, the associations for the NA, C2, and C6 classes approached significance under the FDR-adjusted threshold.

12. Patient treatment: Only 25% patient underwent radiofrequency ablation (RFA).

8 Discussion

8.1 Etiology

In **the original cohort of 486 patients** presenting with chronic lower limb ulcers or other severe dermatologic conditions, no infectious etiology was formally identified through laboratory testing. While this represents a potential limitation, several consistent clinical and contextual factors strongly support the non-infectious nature of these conditions:

- **Anatomical and Clinical Schemas:** All patients exhibit dermatologic manifestations confined to the lower limbs. This distribution aligns with chronic vascular or diabetic pathologies, differing markedly from the more disseminated or anatomically distinct presentations typically observed in infectious diseases such as Buruli ulcer.

- **Clinical Diagnosis:** Each patient has been examined by the author, enabling an evidence-based clinical diagnosis supported by duplex Doppler ultrasonography to evaluate chronic venous insufficiency.
- **Socioeconomic Constraints:** Laboratory investigations require out-of-pocket payment by patients, limiting access to outsourced and costly complementary testing.
- **Demographic Characteristics:** Patients range from 20 to 80 years old, with a median age skewed toward older adults, an age profile inconsistent with infectious diseases like Buruli ulcer, which predominantly affect adolescents. Additionally, all participants are residents of Kinshasa, an urban area where infectious dermatoses, particularly mycobacterial infections, are rare. For example, reported Buruli ulcer cases in Kinshasa number 13 from 2016 to 2018, compared to 74 cases across the entire DRC in 2023. (9) (10)

Taken together, these clinical, demographic, and contextual factors substantially reduce the likelihood—and arguably exclude—the presence of underlying infectious causes in the studied population. In this context, a preliminary analysis of this cohort leads to two primary conclusions.

First, **vascular etiology predominates (393 patients, 81% of cases) over other causes of lower limb dermatologic disorders in this cohort of patients**. Consequently, the idea that infectious causes are a significant or prevalent source of skin wounds, particularly in tropical megacities, appears questionable and is challenged by our findings. It actually highlights the dual burden of non-communicable and infectious diseases that challenges healthcare systems in sub-Saharan African countries. (14) (15) Our observations confirm the significant role of venous pathology in lower limb dermatologic disorders, establishing it as the primary cause of lower limb ulcers, consistent with findings from Western populations. (16)

Second, advanced venous disease levels within our cohort are overwhelming, with **362 patients (92% of cases) classified in CEAP C3-C6 severity categories**. These results contrast with large-scale global epidemiological studies, most notably the Vein Consult Program, which in 2012 reported that 24% of 70,000 screened patients across 13 countries had progressed to CVI (CEAP stages C3–C6), with a prevalence of venous ulcers (healed and active) of 2.1% (1) (17)

The above observations are commonly reported in many low-income settings, where dermatological conditions are often misunderstood by the general population, including educated individuals. These conditions are attributed to mystical or spiritual causes, such as ancestral or familial transgressions, and patients frequently consult traditional healers, spiritual leaders, or religious practitioners before seeking formal medical care. These culturally embedded health-seeking behaviors, combined with a shortage of trained medical personnel and limited access to affordable healthcare, contribute to delayed medical consultations and, consequently, to the high prevalence of advanced CVI stages observed in this study. This stands in stark contrast to trends in high-income countries, where early detection and the broad availability of minimally invasive interventions have significantly slowed disease progression. (18) (19) (20)

8.2 CEAP, age, sex, laterality

Our cohort exhibits a female-to-male ratio of 1.34, which is not statistically different from the ratio of 1.28 observed in the Bonn study. (13)

Patient age and the maximum CEAP classification in the lower limbs shows a negligible association. This finding diverges from the well-established positive correlation between age and CEAP clinical classification. It likely reflects the specific socioeconomic context of Kinshasa, where financial constraints delay healthcare-seeking behavior and alter the natural history of disease presentation. Our results corroborate similar observations reported from other low-income settings. (21) (22) (23)

The tendency for women to present with venous disease at an earlier age than men with the most pronounced divergence observed around age 46 can be attributed to a combination of sociocultural and biological factors. Women are often more health-aware and place greater emphasis on body aesthetics, both of which may lead to increased vigilance and earlier medical consultation. Additionally, well-established risk factors for venous disease, such as hormonal fluctuations related to the menstrual cycle, pregnancy, and menopause, may accelerate disease progression and prompt timelier medical evaluation. Women also tend to present with a broader age range (from their 40s through their 70s) and exhibit a balanced distribution of clinical signs (C3 to C6).

Among men, the highest incidence occurs in those in their 50s, with the greatest age divergence compared to women observed at age 64. Clinical sign C6 peaks at these ages, with a frequency double that seen in other age ranges between 40 and 80. Occupational factors, such as prolonged standing or heavy lifting, may accelerate progression to advanced stages. Men also traditionally bear the primary financial responsibility for their families, which may motivate timely health-seeking behavior when severe disease threatens their capacity to work.

Bilateral limb-level CEAP disease schemas explain 85% of all combination pairs, further refining our findings by demonstrating that females are more frequently affected by symmetrical patterns, whereas males exhibit a higher prevalence of unilateral left-sided disease. Regarding asymmetry, left-sided involvement may be partly attributed to anatomical factors such as compression of the left common iliac vein (May-Thurner syndrome) (24) (25). However, other contributors, such as occupational asymmetry, repetitive strain, or limb dominance, may also play a role..

In summary, our cohort likely represents a delayed, cross-sectional snapshot across the age spectrum, where the disease burden is disproportionately concentrated in severe cases. Significant trends, associated with small effect sizes and negligible model fits, predominantly follow sex and limb-side specific patterns.

9 Conclusions

With respect to Chronic Venous Insufficiency (CVI), our findings highlight a crucial opportunity to strengthen health systems in the rapidly urbanizing Democratic Republic of Congo (DRC). While the rural population is projected to grow from 50 million to 70 million, the urban population is expected to surge dramatically from 30 million in 2025 to 200 million by 2050. When not effectively prevented or treated, severe forms of CVI can result in debilitating physical outcomes such as amputation, as well as profound psychological consequences including social isolation. Although current public health frameworks, including the “WHO Cooperation Strategy with the Democratic People's Republic of Congo 2024–2029,” acknowledge the dual burden of communicable and non-communicable diseases, there remains significant potential to enhance these initiatives by explicitly integrating CVD (Chronic Venous Disease) prevention and CVI management in these policies. Proactively addressing this silent epidemic, a cause of severe dermatologic complications, would directly align with the priorities of the 78th World Health Assembly (Geneva, 2025). Its resolution, 'Skin diseases as a global public health priority,' calls for prevention, early detection, treatment, burden reduction, and increased awareness of skin diseases and related conditions. (26) (27) (28)

10 Recommendations

At the community level in Kinshasa, the term “MBASU” encompasses diverse dermatological signs, including simple erythema or papules, unsightly wounds, edema or fibrosis, and healed or active ulcers. By echoing late 20th-century views, this usage perpetuates misconceptions in public health policy, as it has traditionally been narrowly associated with infectious causes such as Buruli ulcer. Therefore, to promote clarity in language, we propose adopting the terms “Non-infectious MBASU (NIM)” and “Infectious MBASU (IM),” emphasizing a necessary semantic and conceptual shift. It is vital that vernacular terminology reflects the scientific evidence provided by this study, ensuring that collective understanding incorporates this crucial distinction.

Strategically, the importance of CVI, an eminently manageable condition with timely intervention, underscores significant opportunities for targeted healthcare investment and policy development, including:

Funding prioritization: Private and public funding should be primarily directed towards managing vascular-related conditions (direct costs) and implementing measures to alleviate the economic burden (indirect costs) of this scourge.
Public Awareness Campaigns: Information, awareness, screening, and prevention campaigns should be conducted, emphasizing the benefits of early detection and the treatable nature of vascular diseases.
Hospital Assessment: At initial presentation, hospitals should consider the possibility of “Non-infectious MBASU (NIM)”, thereby prioritizing Chronic Venous Disease (CVD) or, in advanced stages, Chronic Venous Insufficiency (CVI) when managing lower limb ulcer wounds.
Medical Education Reform: Higher education curricula for medical and nursing students should incorporate the significant importance of therapies related to vascular conditions. (29)
Collaborative Expertise: We propose to establish shared expertise between vascular and infectious disease specialists to optimize available resources for the benefit of patient health.

11 Funding

This study is self-funded.

12 Conflict of interest

None.

13 Keywords

chronic venous insufficiency, clinical epidemiology, CEAP clinical signs, patient demography

14 References

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