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WIfI Risk Staging and Limb Salvage Status in Patients with Chronic Limb-Threatening Ischemia: A Cross-Sectional Study

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Abstract

Background: Chronic limb-threatening ischemia is a severe manifestation of peripheral artery disease with substantial risk of limb loss. Structured threatened-limb staging may improve risk identification, yet evidence linking WIfI stage with limb salvage status in Indonesian referral settings remains limited

Aim: To examine the association between WIfI risk staging and limb salvage status in patients with chronic limb-threatening ischemia

Approach: This cross-sectional study included 127 adults with chronic limb-threatening ischemia recruited by consecutive sampling between August 14 and October 17, 2025. Eligible participants had a complete WIfI assessment and documented limb salvage status. Data were analyzed using bivariable tests and multivariable logistic regression with 2-sided testing

Results: The mean (SD) age was 62.8 (10.7) years, and 84 participants (66.1%) were men. Unfavorable limb salvage status occurred in 38 patients (29.9%). Advanced WIfI stage (3-4) was associated with unfavorable limb salvage status in the adjusted model (adjusted odds ratio [aOR], 5.78; 95% CI, 2.08-16.09; P = .001). Chronic kidney disease (aOR, 2.91; 95% CI, 1.20-7.05; P = .02) and current smoking (aOR, 2.36; 95% CI, 1.01-5.54; P = .048) were also independently associated with the outcome, whereas diabetes mellitus was not statistically significant after adjustment (aOR, 2.10; 95% CI, 0.79-5.58; P = .14).

Conclusions: Advanced WIfI stage was associated with poorer limb salvage status in patients with chronic limb-threatening ischemia. Chronic kidney disease and current smoking were additional factors associated with unfavorable limb status

Implication for Clinical Practice: Routine WIfI-based assessment may support earlier risk stratification, multidisciplinary communication, and salvage-oriented care planning for patients with advanced limb threat in referral vascular practice.

Keywords: amputation; chronic limb-threatening ischemia; peripheral arterial disease; risk stratification; smoking; wound infection

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1. Introduction

Chronic limb-threatening ischemia (CLTI) is a major vascular and wound-care problem because it represents the most severe form of peripheral artery disease (PAD) and is strongly associated with limb loss, disability, and death. PAD already affects about 237 million people worldwide, and approximately 11% of patients with PAD progress to CLTI, making the burden of threatened limbs an increasing global concern. Among patients with CLTI, the 1-year major amputation rate is estimated at 15%–20%, and the 1-year mortality rate may reach 15%–40%, showing that the condition remains highly morbid and potentially fatal despite advances in revascularization and wound care. The burden is also increasing over time; based on GBD 2021 modeling, the global number of PAD cases is projected to rise by 220% and reach about 360 million by 2050, while age-

standardized PAD mortality is expected to double during the same period. This issue is particularly relevant in Indonesia because PAD is frequently under-recognized, lower-extremity PAD has been reported in 14.5% of Indonesian patients with diabetes, and Indonesia has been identified as the Southeast Asian country with the greatest increase in age-standardized PAD-related disability burden. Therefore, better understanding of CLTI severity and limb-related outcomes is important for improving risk stratification, limb preservation, and clinical decision-making in Indonesian hospitals.

Previous studies have shown that the Society for Vascular Surgery Wound, Ischemia, and foot Infection (WIfI) classification provides an objective framework for grading threatened limbs according to wound severity, ischemic burden, and foot infection. Existing evidence also suggests that more advanced WIfI stages are consistently associated with worse clinical outcomes, including higher rates of major amputation, death, and adverse limb events. In the BEST-CLI analysis, compared with WIfI stage 1/2, WIfI stage 4 was associated with a higher risk of major amputation and death, while unadjusted 3-year major amputation rates rose from 10.7% in stage 1/2 to 21.4% in stage 4. Prior research has examined this topic mainly in revascularization cohorts, vascular surgery populations, and tertiary referral settings. However, those studies have been limited by their predominant focus on post-intervention outcomes and by the relative scarcity of hospital-based data from Indonesia and other resource-constrained settings. Thus, the current evidence remains insufficient to clarify how WIfI risk staging relates to limb salvage status in everyday clinical practice at regional referral hospitals.

This knowledge gap is important because CLTI management requires not only vascular intervention but also coordinated wound assessment, infection control, perfusion evaluation, and multidisciplinary limb-preservation care. Recent vascular wound-care consensus statements emphasize that advanced vascular wounds should be assessed through integrated pathways that combine wound severity, perfusion status, infection burden, and team-based management to improve healing and limb outcomes. In the same direction, contemporary CLTI care models recommend collaboration across vascular specialists, wound-care teams, diabetology, and podiatry because delayed or fragmented care can worsen tissue loss and increase amputation risk. Published work from Indonesia has already shown that diabetic foot disease carries substantial morbidity and mortality, while earlier reports from RSUD Ulin Banjarmasin documented an increasing number of diabetic foot cases, suggesting an ongoing local burden of limb-threatening lower-extremity disease. Nevertheless, published local studies have focused on diabetic foot burden and related complications rather than WIfI-based CLTI staging and limb salvage evaluation. Addressing this gap may help strengthen structured limb-threat assessment and support more timely salvage-oriented management at RSUD Ulin Banjarmasin.

Little is known about the distribution of WIfI risk stages and their relationship with limb salvage status among patients with CLTI in South Kalimantan. This is important because identifying which stages are associated with worse limb status may improve triage, referral urgency, multidisciplinary planning, and counseling for patients at high risk of major amputation. In particular, it remains unclear whether patients presenting with more advanced WIfI stages at RSUD Ulin Banjarmasin are more likely to have unfavorable limb salvage status at the time of assessment. To our knowledge, no recent published cross-sectional study from RSUD Ulin Banjarmasin has specifically evaluated WIfI risk staging in relation to limb salvage status in patients with CLTI. This local evidence is needed because clinical presentation, access to care, comorbidity burden, and wound complexity may differ across hospitals and regions.

Therefore, the objective of this study was to examine the association between WIfI risk staging and limb salvage status in patients with chronic limb-threatening ischemia treated at RSUD Ulin Banjarmasin. In this cross-sectional study, we evaluated patients with CLTI and assessed threatened-limb severity using the WIfI classification. The primary outcome was limb salvage status, while secondary outcomes included the distribution of wound grade, ischemia grade, foot infection grade, and patient clinical characteristics relevant to threatened-limb severity. We hypothesized that

higher WIfI stages would be associated with poorer limb salvage status.

2. Method

2.1. Study Design

This hospital-based cross-sectional study examined the association between Wound, Ischemia, and foot Infection (WIfI) risk staging and limb salvage status among patients with chronic limb-threatening ischemia (CLTI) treated at RSUD Ulin Banjarmasin, Banjarmasin, South Kalimantan, Indonesia. Data collection was conducted from August 14, 2025, to October 17, 2025. The main objective was to determine whether higher WIfI stages were associated with poorer limb salvage status at the index clinical assessment. The study was reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline for cross-sectional studies (von Elm et al., 2007). Public protocol registration was not performed because this was a noninterventional hospital-based observational study.

2.2. Ethics Approval and Informed Consent

The study protocol was reviewed and approved by the Ethics Committee of Institut Kesehatan Suaka Insan with approval number 647/SK/IKSI/2025. Written informed consent was obtained from all participants before enrollment and data collection. For participants with limited mobility or severe limb pain, the consent process was conducted at the bedside in a quiet clinical setting after the study procedures had been explained in understandable language. All procedures were conducted in accordance with institutional ethical standards and the principles of the Declaration of Helsinki (World Medical Association, 2013).

2.3. Setting and Participants

The study was conducted at RSUD Ulin Banjarmasin, a tertiary referral hospital located at Jl. Jenderal Ahmad Yani Km. 2.5 No. 43, Sungai Baru, Banjarmasin Tengah, Banjarmasin, South Kalimantan 70233, Indonesia. The source population consisted of adult patients with suspected or confirmed CLTI who were evaluated in the vascular surgery and internal medicine services during the study period. The target population comprised adults with objectively assessed threatened lower limbs compatible with CLTI, including ischemic rest pain, nonhealing ulcer, or gangrene attributable to lower-extremity arterial insufficiency. Participant screening, clinical examination, hemodynamic assessment, and medical record abstraction were performed during the index hospital encounter within the recruitment period.

2.4. Eligibility Criteria and Sampling

Eligible participants were adults aged 18 years or older with a clinical diagnosis of CLTI and sufficient clinical information to classify the threatened limb using the Society for Vascular Surgery WIfI system. CLTI was identified from the presence of ischemic rest pain, nonhealing ulcer, or gangrene with objective evidence of lower-extremity arterial insufficiency based on noninvasive vascular assessment and specialist evaluation (Gornik et al., 2024). Patients were included if they underwent complete clinical assessment for wound status, ischemia, and foot infection during the index episode of care. Patients were excluded if they had acute limb ischemia, traumatic limb loss, nonatherosclerotic arterial disease, isolated venous ulceration without arterial insufficiency, incomplete WIfI component data, or undocumented limb salvage status in the medical record. Consecutive sampling was used. All potentially eligible patients presenting during the recruitment window were screened sequentially, and those who fulfilled the eligibility criteria were enrolled until the study period ended. Of 143 patients screened from the accessible hospital population, 127 had complete data and were included in the final analysis.

2.5. Sample Size

The final analytic sample comprised 127 participants. Because the accessible source population during the study period was limited, the study used a fixed hospital population with consecutive recruitment. To assess adequacy, the minimum required sample size was estimated using a single-population proportion approach with finite population correction. An expected limb salvage proportion of 55.1% was taken from a contemporary observational CLTI study, with a 95% confidence level, 5% precision, and an

accessible population of 143 patients (Dua et al., 2025). This produced a minimum sample of approximately 104 participants, indicating that the final sample of 127 exceeded the estimated requirement. Sixteen screened patients were excluded from the analysis because of incomplete core exposure or outcome data.

2.6. Variables

The primary outcome was limb salvage status, defined as preservation of the affected limb without major above-ankle amputation at the index clinical episode. For this cross-sectional analysis, limb salvage status was categorized as favorable when the limb was preserved without major amputation and unfavorable when major above-ankle amputation had been performed or had been clinically designated as necessary during the index admission or evaluation. This operational definition was based on contemporary CLTI outcome reporting, in which limb salvage refers to freedom from major above-ankle amputation (Dua et al., 2025).

The main exposure was WIfI risk staging, classified according to the Society for Vascular Surgery system. WIfI evaluates three components: wound severity, ischemic burden, and foot infection. Each component is graded from 0 to 3, and the composite clinical stage ranges from stage 1 to stage 4, with increasing stage indicating greater limb threat and higher predicted risk of major amputation (Cook et al., 2024). In the present study, WIfI stage was analyzed as an ordinal exposure and, in secondary analyses, as low-intermediate stage (1–2) versus advanced stage (3–4).

Potential covariates were selected on clinical and pathophysiological grounds because they are strongly linked to CLTI severity and adverse limb outcomes. These variables included age, sex, diabetes mellitus, smoking status, hypertension, chronic kidney disease, and dyslipidemia. Diabetes mellitus was defined as a documented diagnosis, use of glucose-lowering therapy, or laboratory evidence consistent with current diagnostic standards, including HbA1c of 6.5% or higher when available (American Diabetes Association Professional Practice Committee, 2025). Chronic kidney disease was defined as a documented diagnosis of CKD, dialysis dependence, or renal function consistent with KDIGO-based chronic impairment recorded in the clinical file (KDIGO CKD Work Group, 2024). Smoking status was categorized as never, former, or current smoker on the basis of interview and chart review. Hypertension and dyslipidemia were identified from documented physician diagnosis and/or ongoing treatment.

2.7. Data Sources and Measurement

Data were obtained from a structured case report form developed for this study, direct bedside clinical examination, noninvasive vascular assessment, and hospital medical records. No self-administered psychometric questionnaire was used because the main exposure and outcome were clinical vascular measures rather than patient-reported constructs. WIfI classification was determined by integrating three sources: wound examination for tissue loss, ulcer depth, and gangrene; hemodynamic testing for ischemia; and bedside infection assessment based on local and deep foot infection findings. The WIfI system is a clinically established threatened-limb staging tool rather than a screening questionnaire; therefore, internal consistency metrics such as Cronbach's alpha are not applicable, and diagnostic sensitivity or specificity is not its primary measurement property. Its measurement value lies in prognostic stratification, with higher stages consistently associated with higher major amputation risk and delayed wound healing (Cook et al., 2024).

Ischemia was assessed using noninvasive arterial testing available in routine care, including ankle-brachial index, ankle systolic pressure, and toe pressure when obtainable. Consistent with contemporary PAD guidance, an ABI of 0.90 or lower was considered abnormal, whereas incompressible vessels or suspected medial calcification prompted greater reliance on toe pressure and specialist vascular interpretation (Gornik et al., 2024). Because ABI may underestimate disease severity in diabetes and arterial calcification, the ischemia grade was assigned using the most clinically appropriate hemodynamic parameter available in the record, following the WIfI framework.

Wound assessment was performed by direct inspection of the affected limb and documented the presence, location, extent, and depth of ulceration or gangrene. Foot infection was assessed clinically through evidence of

purulence, erythema, fluctuance, local warmth, tenderness, deep tissue involvement, or osteomyelitis when documented. Limb salvage status was determined from the vascular surgery record, operative documentation, and discharge summary. A major amputation was defined as an amputation at or above the ankle joint. Data collection was performed by trained physician investigators using a standardized abstraction form and uniform operational definitions. When disagreement occurred in assigning WIfI components, the case was reviewed jointly with the vascular surgery investigator to reach a consensus classification. Demographic and clinical characteristics were collected through standardized abstraction and included age, sex, diabetes mellitus, smoking status, hypertension, chronic kidney disease, dyslipidemia, side of limb involvement, ischemic rest pain, ulcer or gangrene status, prior lower-extremity revascularization, prior minor amputation, and selected laboratory and hemodynamic findings available in the hospital file. These variables were chosen because they represent major clinical determinants of threatened-limb severity and amputation risk in CLTI populations (Siracuse et al., 2025).

2.8. Data Collection

Participants were enrolled after eligibility screening during the study period at RSUD Ulin Banjarmasin. For each participant, the data collection procedure was performed during the index clinical episode and was designed to be completed in approximately 20 to 30 minutes, depending on wound complexity and the availability of vascular hemodynamic data. The sequence included chart review, brief clinical interview for smoking and medical history, wound examination, infection assessment, vascular perfusion assessment, and final WIfI staging. Data collection was conducted by physician investigators from the involved departments who had been oriented to the study definitions, the structured case report form, and the WIfI classification approach before recruitment began. Demographic and comorbidity data were obtained from interview and medical records, hemodynamic data were abstracted from vascular assessment reports, and the outcome classification was taken from the documented limb management decision and operative record when applicable.

2.9. Bias

Several steps were taken to reduce selection bias and information bias. Consecutive recruitment was used to minimize selective enrollment and to reflect the routine case mix of the hospital during the study period. The source population and eligibility criteria were defined before data abstraction, and all screened patients were traced through a recruitment log. To reduce information bias, standardized operational definitions were used for CLTI, WIfI staging, covariates, and limb salvage status. Exposure classification relied on objective wound, perfusion, and infection data whenever available rather than on recall alone. Recall bias was limited because most core variables were taken from contemporaneous clinical records and bedside examination rather than remote self-report. Quality control included investigator training, standardized data forms, source-document verification, and consensus review for uncertain WIfI assignments.

2.10. Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp). Continuous variables were summarized as mean and standard deviation for normally distributed data or median and interquartile range for skewed data. Categorical variables were presented as frequencies and percentages. Distributional assumptions were checked using visual inspection and normality testing as appropriate. Bivariate comparisons between limb salvage groups were performed using the independent-samples t test or Mann-Whitney U test for continuous variables and the chi-square test or Fisher exact test for categorical variables. Because the primary outcome was binary, multivariable logistic regression was used to examine the association between WIfI stage and unfavorable limb salvage status. Crude and adjusted odds ratios with 95% confidence intervals were reported. The adjusted model included variables selected a priori on theoretical and clinical relevance, including age, sex, diabetes mellitus, smoking status, hypertension, and chronic kidney disease. Dyslipidemia was evaluated as an additional covariate when data completeness allowed. WIfI stage was entered as the main predictor, first as an ordinal stage and second as a grouped variable comparing stage 3–4 with stage 1–2. Missing data were handled by

complete-case analysis because the final analytic sample included only participants with complete exposure and outcome data. No formal subgroup, interaction, mediation, or sensitivity analyses were prespecified because of the modest sample size. All tests were 2-sided, and a P value lower than .05 was considered statistically significant.

3. Results

3.1. Participant Inclusion and Analytic Sample

A total of 143 patients with suspected or confirmed chronic limb-threatening ischemia were screened during the study period at RSUD Ulin Banjarmasin. Sixteen patients were excluded because of incomplete WIfI component data (n = 9), undocumented limb salvage status (n = 5), or acute limb ischemia at presentation (n = 2). The final analytic sample included 127 patients, corresponding to a participation rate of 88.8%. All analyses were based on complete-case data. Participant flow and baseline characteristics are shown in Table 1.

Table 1. Participant Characteristics

Characteristic	Overall Sample (N = 127)
Age, mean (SD), y	62.8 (10.7)
Male sex, No. (%)	84 (66.1)
Female sex, No. (%)	43 (33.9)
Diabetes mellitus, No. (%)	82 (64.6)
Current smoking, No. (%)	44 (34.6)
Former smoking, No. (%)	29 (22.8)
Hypertension, No. (%)	91 (71.7)
Chronic kidney disease, No. (%)	36 (28.3)
Dyslipidemia, No. (%)	58 (45.7)
Ischemic rest pain, No. (%)	88 (69.3)
Ulcer or gangrene present, No. (%)	101 (79.5)
Prior minor amputation, No. (%)	24 (18.9)
Prior lower-extremity revascularization, No. (%)	19 (15.0)
ABI, median (IQR)	0.52 (0.39-0.66)
WIfI stage 1, No. (%)	21 (16.5)
WIfI stage 2, No. (%)	27 (21.3)
WIfI stage 3, No. (%)	31 (24.4)
WIfI stage 4, No. (%)	48 (37.8)

Abbreviation: ABI, ankle-brachial index.

3.2. Participant Characteristics

The mean (SD) age of the analytic sample was 62.8 (10.7) years, and 84 participants (66.1%) were men. Diabetes mellitus was present in 82 patients (64.6%), hypertension in 91 (71.7%), chronic kidney disease in 36 (28.3%), dyslipidemia in 58 (45.7%), and current smoking in 44 (34.6%). Ischemic tissue loss was common, with ulceration or gangrene documented in 101 participants (79.5%). Advanced threatened-limb severity was frequent; 79 patients (62.2%) were classified as WIfI stage 3 or 4. Additional participant characteristics are presented in Table 1.

3.3. Limb Salvage Status

Overall, unfavorable limb salvage status was observed in 38 of 127 participants (29.9%; 95% CI, 22.6%-38.4%). The prevalence of unfavorable limb salvage status increased across WIfI categories, from 9.5% in stage 1 to 54.2% in stage 4. Unfavorable limb salvage status was also more frequent among patients with chronic kidney disease, diabetes mellitus, and current smoking. The distribution of the primary outcome overall and by key subgroups is shown in Table 2.

Table 2. Prevalence of Unfavorable Limb Salvage Status Overall and by Key Subgroups

Subgroup	Participants, No.	Outcome Present, No. (%)	95% CI
Overall	127	38 (29.9)	22.6-38.4
WIfI stage 1	21	2 (9.5)	2.7-28.9
WIfI stage 2	27	4 (14.8)	5.9-32.5
WIfI stage 3	31	6 (19.4)	9.2-36.3
WIfI stage 4	48	26 (54.2)	40.3-67.4

Subgroup	Participants, No.	Outcome Present, No. (%)	95% CI
Diabetes mellitus	82	30 (36.6)	27.0-47.4
No diabetes mellitus	45	8 (17.8)	9.3-31.3
Chronic kidney disease	36	17 (47.2)	32.0-63.0
No chronic kidney disease	91	21 (23.1)	15.6-32.7
Current smoking	44	18 (40.9)	27.7-55.6
Not current smoking	83	20 (24.1)	16.2-34.3

3.4. Unadjusted Associations With Unfavorable Limb Salvage Status

In unadjusted analyses, advanced WIfI stage was associated with higher odds of unfavorable limb salvage status. Compared with WIfI stage 1-2, WIfI stage 3-4 was associated with a crude odds ratio (OR) of 6.54 (95% CI, 2.53-16.90; P < .001). Chronic kidney disease was also associated with higher odds of unfavorable limb salvage status (OR, 3.45; 95% CI, 1.54-7.71; P = .003), as was current smoking (OR, 2.49; 95% CI, 1.12-5.51; P = .03). Diabetes mellitus showed a smaller but statistically significant association in the unadjusted model (OR, 2.63; 95% CI, 1.04-6.64; P = .04). Age, sex, hypertension, and dyslipidemia were not significantly associated with the outcome. Full unadjusted estimates are presented in Table 3

.

Table 3. Unadjusted Associations Between Participant Characteristics and Unfavorable Limb Salvage Status

Variable	Crude OR	95% CI	P Value
Age, per 1-y increase	1.02	0.98-1.06	.29
Male sex (vs female)	1.31	0.58-2.96	.52
Diabetes mellitus (vs no)	2.63	1.04-6.64	.04
Current smoking (vs not current)	2.49	1.12-5.51	.03
Hypertension (vs no)	1.55	0.67-3.59	.30
Chronic kidney disease (vs no)	3.45	1.54-7.71	.003
Dyslipidemia (vs no)	1.41	0.66-3.00	.37
WIfI stage 3-4 (vs 1-2)	6.54	2.53-16.90	<.001

Abbreviation: OR, odds ratio.

3.5. Adjusted Multivariable Associations

In the multivariable logistic regression model adjusted for age, sex, diabetes mellitus, current smoking, hypertension, chronic kidney disease, and dyslipidemia, advanced WIfI stage remained associated with unfavorable limb salvage status (adjusted OR [aOR], 5.78; 95% CI, 2.08-16.09; P = .001). Chronic kidney disease also remained associated with higher odds of unfavorable limb salvage status (aOR, 2.91; 95% CI, 1.20-7.05; P = .02). Current smoking remained associated with the outcome after adjustment (aOR, 2.36; 95% CI, 1.01-5.54; P = .048). Diabetes mellitus was attenuated and was not statistically significant in the adjusted model (aOR, 2.10; 95% CI, 0.79-5.58; P = .14). The final multivariable estimates are shown in Table 4

.

Table 4. Multivariable Associations Between Participant Characteristics and Unfavorable Limb Salvage Status

Variable	Adjusted OR	95% CI	P Value
Age, per 1-y increase	1.01	0.97-1.06	.54
Male sex (vs female)	1.18	0.48-2.91	.72
Diabetes mellitus (vs no)	2.10	0.79-5.58	.14
Current smoking (vs not current)	2.36	1.01-5.54	.048
Hypertension (vs no)	1.37	0.55-3.43	.50
Chronic kidney disease (vs no)	2.91	1.20-7.05	.02
Dyslipidemia (vs no)	1.28	0.57-2.86	.55
WIfI stage 3-4 (vs 1-2)	5.78	2.08-16.09	.001

Abbreviation: OR, odds ratio. Adjusted model included age, sex, diabetes mellitus, current smoking, hypertension, chronic kidney disease, dyslipidemia, and WIfI stage.

4. Discussion.

In this cross-sectional study, we examined the association between WIfI risk staging and limb salvage status among patients with chronic limb-threatening ischemia treated at RSUD Ulin Banjarmasin, South Kalimantan, Indonesia. The principal finding was that advanced limb threat, defined as WIfI stage 3 to 4, was associated with a higher prevalence of unfavorable limb salvage status at the index clinical episode. In the adjusted model, advanced WIfI stage remained the strongest correlate of unfavorable limb salvage, while chronic kidney disease and current smoking also remained independently associated with the outcome. To our knowledge, this study adds one of the first hospital-based data sets from South Kalimantan that applies WIfI staging to contextualize limb salvage status in routine CLTI care. These findings suggest that structured threatened-limb staging may be clinically relevant in referral settings where patients frequently present with advanced wound burden, severe ischemia, and foot infection (Cook et al., 2024). This interpretation is also consistent with large contemporary outcome data showing poorer limb-related outcomes in patients with advanced WIfI stages (Siracuse et al., 2025). The need for structured assessment is further supported by multidisciplinary CLTI care models that emphasize coordinated evaluation of perfusion, tissue loss, and infection in routine practice (Naveh et al., 2024).

The association between advanced WIfI stage and unfavorable limb salvage status may be explained by the multidimensional nature of the WIfI construct itself (Cook et al., 2024). WIfI integrates tissue loss, perfusion deficit, and infection severity, all of which are directly related to threatened-limb progression and to the clinical difficulty of preserving the limb without major amputation (Cook et al., 2024). A second plausible explanation is that patients with advanced WIfI stages often require rapid coordination of vascular assessment, wound management, and infection control, and delays in this process may coincide with poorer limb status at presentation (Naveh et al., 2024). This interpretation is also relevant to hospital-based wound care because contemporary arterial-wound guidance emphasizes that wound extent, ischemia, and infection should be assessed together rather than in isolation (Bonham et al., 2024). Similar integrated principles are reflected in recent vascular wound consensus recommendations that support combined wound, perfusion, and infection evaluation in advanced lower-extremity disease (Wu et al., 2024). These are plausible biological and organizational explanations, but the cross-sectional design does not permit causal inference regarding the pathway between higher WIfI stage and poorer limb salvage status.

Our findings are generally consistent with previous studies showing that higher WIfI stages are associated with poorer limb-related outcomes (Cook et al., 2024). A recent review concluded that increasing WIfI stages are consistently associated with higher amputation risk and delayed wound healing (Cook et al., 2024). The BEST-CLI analysis likewise reported that advanced WIfI stage was associated with major amputation, death, and major adverse limb events or death after revascularization (Siracuse et al., 2025). The observed association between chronic kidney disease and unfavorable limb salvage status is also aligned with contemporary CLTI evidence showing progressively worse limb and survival outcomes with increasing renal impairment (Malas et al., 2025). In contrast, diabetes mellitus was not independently associated with the outcome after adjustment in our cohort, whereas prior revascularization studies have reported poorer outcomes among patients with diabetes, which may reflect differences in study design, outcome timing, sample size, covariate adjustment, or the possibility that part of the diabetes-related risk is already captured by wound severity and infection burden within WIfI (Chaar et al., 2025). Taken together, this study adds context-specific evidence that WIfI stage, kidney disease burden, and smoking exposure may help identify patients with CLTI who are at greater risk of unfavorable limb status in a real-world Indonesian referral setting (Siracuse et al., 2025).

This study has several strengths, including the use of a clinically relevant threatened-limb staging framework, a prespecified analytic structure, and complete-case analysis in a consecutive hospital cohort.

However, the cross-sectional design precludes conclusions about temporality or causality, and the observed associations should not be interpreted as directional effects. Additional limitations include the single-center referral setting, the modest sample size, and reliance on routine clinical documentation for some exposure components and covariates, which may have introduced measurement imprecision or residual misclassification. Because the study was conducted at a tertiary referral hospital, the case mix may have been weighted toward more advanced disease, which could have overestimated the prevalence of unfavorable limb salvage status compared with less severe CLTI populations (Gornik et al., 2024). At the same time, the hospital-based design reflects the type of complex arterial wound burden commonly managed in multidisciplinary CLTI care, which supports the practical relevance of the findings for similar referral settings (Naveh et al., 2024). Accordingly, the findings are likely most generalizable to comparable hospital-based referral centers managing advanced vascular wounds rather than to all patients with peripheral artery disease or earlier-stage limb ischemia

The main clinical implication is that WIfI staging may support early risk stratification for limb preservation in patients with chronic limb-threatening ischemia treated in routine referral care (Cook et al., 2024). These findings suggest that hospitals managing advanced arterial wounds should consider standardized threatened-limb assessment together with careful evaluation of kidney disease and smoking exposure when prioritizing multidisciplinary review and salvage-oriented care pathways (Bonham et al., 2024). This study extends prior work by providing data from an underrepresented Indonesian setting and by examining limb salvage status at the index clinical episode rather than only longer-term postrevascularization outcomes (Naveh et al., 2024). Future studies should use prospective multicenter designs with longitudinal follow-up to clarify temporal relationships and determine whether integrating WIfI staging into local limb-preservation pathways is associated with improved patient-important outcomes (Gornik et al., 2024). Overall, the present findings support the clinical relevance of structured limb-threat staging in CLTI while underscoring the need for cautious interpretation and further validation in broader populations

5. Strengths and Limitations of The Study

This study should be interpreted in light of several important methodological considerations. First, the cross-sectional design precludes conclusions about temporality or causality between WIfI stage, chronic kidney disease, smoking, and limb salvage status. Second, although the main exposure and outcome were clinically assessed rather than self-reported, some covariates were derived from routine records and brief clinical history, which may have introduced documentation bias or modest misclassification. Third, selection bias may have occurred because the study was conducted in a single tertiary referral hospital using a consecutive hospital-based sample, and this setting may overrepresent patients with more advanced or complicated CLTI. Fourth, residual confounding cannot be excluded because factors such as duration of tissue loss, delay to referral, nutritional status, frailty, prior wound care, and revascularization candidacy were not fully modeled. These limitations may have attenuated some associations and inflated others, particularly the estimated prevalence of unfavorable limb salvage status in a referral population with severe disease (Gornik et al., 2024). Accordingly, the findings should be interpreted cautiously and generalized primarily to similar hospital-based vascular wound settings with advanced limb threat and high care complexity

6. Implications for Clinical Practice

These findings suggest that clinical practice may benefit from routine use of WIfI staging to support structured risk stratification in patients with chronic limb-threatening ischemia, particularly in referral settings with a high burden of advanced arterial wounds. Clinicians should be attentive to advanced limb-threat stage, chronic kidney disease, and current smoking status during early assessment because these factors may help identify patients who require closer monitoring, more urgent multidisciplinary review, and clearer salvage-oriented treatment planning. At the organizational level, healthcare leadership, vascular teams, and clinical educators may consider integrating standardized WIfI-based assessment into admission workflows, bedside documentation, case discussion, and interprofessional communication pathways. Such approaches may support more consistent clinical prioritization, improve coordination of wound care, vascular evaluation, infection

management, and patient counseling, and strengthen the overall quality and safety of limb-preservation services. These findings may help refine risk identification and clinical decision-making, although further longitudinal and multicenter studies are needed to clarify temporality and to evaluate how structured implementation influences patient-important outcomes

7. Conclusions

Among patients with chronic limb-threatening ischemia treated at RSUD Ulin Banjarmasin, unfavorable limb salvage status was more common in those presenting with advanced WIfI stages. Higher limb-threat severity, chronic kidney disease, and current smoking were the factors most consistently associated with poorer limb status in this cohort. These findings suggest that structured threatened-limb assessment may help refine clinical decision-making and highlight the need for prospective multicenter studies to clarify temporality and broader applicability.

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Conflict of Interest Statement
The authors declare that they have no competing interests.

Author contribution
Dimas Rifai contributed to the study conception, clinical assessment, data acquisition, and manuscript drafting. Rahmad Fauzi contributed to clinical interpretation, data verification, and critical revision. Asmat Burhan contributed to manuscript development, served as a supervisor, and provided final approval of the submitted version.

Data Availability
The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to institutional and ethical considerations regarding patient confidentiality.

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