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Prevalence of Peripheral Arterial Disease and Chronic Limb-Threatening Ischemia Among Patients with Diabetes Mellitus in Indonesia: A Systematic Review and Meta-Analysis

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Abstract

Background: Peripheral arterial disease (PAD) and chronic limb-threatening ischemia (CLTI) contribute substantially to diabetes-related limb complications, including impaired wound healing and amputation. However, Indonesian prevalence estimates remain inconsistent across clinical settings, patient populations, and vascular assessment methods, limiting effective healthcare planning.

Aim: To estimate the pooled prevalence of PAD and CLTI among patients with diabetes mellitus in Indonesia and explore associated heterogeneity.

Approach: This systematic review searched six databases through August 26, 2026. Observational studies involving Indonesian patients with diabetes and reporting PAD or CLTI prevalence were eligible. Meta-analysis estimated pooled prevalence; subgroup analyses, meta-regression, and Cochran's Q and I^2 assessed heterogeneity.

Results: Twelve studies involving at least 2,253 participants were identified. Pooled PAD prevalence was 25%, and CLTI prevalence was 61%. Heterogeneity was substantial (I^2 = 93.39% and 93.98%, respectively). Male proportion was associated with PAD prevalence ($p = 0.007$), with significant differences by study setting ($p = 0.002$) and assessment method ($p < 0.001$).

Conclusions: PAD and CLTI were frequently reported among Indonesian patients with diabetes, although substantial heterogeneity limits generalizability. Standardized diagnostic approaches and representative population-based studies are needed.

Implication for Clinical Practice: Clinicians should prioritize vascular assessment in patients with diabetes, particularly those with foot ulcers, using appropriate perfusion tests and timely referral pathways for suspected limb-threatening ischemia.

Keywords: diabetes mellitus; Indonesia; ischemia; meta-analysis; peripheral arterial disease; prevalence; systematic review.

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Introduction

Peripheral arterial disease (PAD) and chronic limb-threatening ischemia (CLTI) are major vascular complications of diabetes mellitus (DM), contributing to impaired wound healing, lower-extremity amputation, and premature mortality. Globally, the number of individuals with PAD increased from 65.8 million in 1990 to 113 million in 2019, representing an approximately 72% increase (GBD 2019 Peripheral Artery Disease Collaborators, 2023). In the Western Pacific region, approximately 215 million adults were living with diabetes in 2024, with the number projected to increase to 254 million by 2050 (International Diabetes Federation [IDF], 2025). Indonesia faces a substantial and growing burden, with diabetes cases projected to increase from 20.4 million in 2024 to 28.6 million by 2050 (IDF,

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2025). Among patients with diabetic foot ulcers, PAD is associated with delayed healing, amputation, and reduced survival (Burhan et al., 2025). Early identification of lower-extremity ischemia is therefore essential to prevent limb loss and improve clinical outcomes.

Previous studies have demonstrated a substantial burden of diabetes-related vascular complications. A global systematic review and meta-analysis involving 155 studies reported a pooled PAD prevalence of 19%, with a higher prevalence in developing than developed countries (24% vs. 10%) (Burhan et al., 2026). Evidence from Indonesia has also highlighted the importance of vascular assessment in diabetic foot management. Burhan et al. (2025) reported that PAD was associated with poorer amputation-free survival and delayed wound healing among patients with diabetic foot ulcers. Clinical guidelines further recommend combining ankle-brachial index, toe-brachial index, and pedal Doppler waveform assessment because no single test reliably excludes PAD in patients with diabetes (Fitridge et al., 2024). However, existing studies vary in patient characteristics, clinical settings, diagnostic methods, and study designs, limiting direct comparisons of reported prevalence estimates.

Despite growing evidence, the pooled prevalence of PAD and CLTI among patients with diabetes in Indonesia remains insufficiently characterized. Available studies frequently focus on individual hospitals or communities, and differences in diagnostic criteria and patient selection may contribute to substantial variation in prevalence estimates. Furthermore, evidence on whether age, sex, study setting, diabetes type, and vascular assessment methods explain differences in PAD prevalence remains limited. A country-specific synthesis is therefore needed to quantify the burden of both conditions and identify potential sources of heterogeneity. Such evidence may support improved vascular screening, earlier referral, and more effective limb-salvage strategies within Indonesian diabetes care services.

Therefore, this systematic review and meta-analysis aimed to estimate the pooled prevalence of PAD and CLTI among patients with diabetes mellitus in Indonesia. The primary outcomes were the pooled prevalence of PAD and CLTI with 95% confidence intervals. Secondary analyses examined between-study heterogeneity, potential publication bias, and differences in PAD prevalence according to age, male proportion, study setting, study design, diabetes type, and assessment method. We hypothesized that prevalence estimates would vary across clinical settings, patient characteristics, and diagnostic approaches.

Methods

Data Sources and Search Strategies

This systematic review and meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines. A comprehensive literature search was conducted in PubMed, Embase, Scopus, and Web of Science, supplemented by Google Scholar and Garuda. The final search was completed on August 26, 2026. The search strategy combined Medical Subject Headings (MeSH), free-text keywords, and Boolean operators (AND/OR) using the following search string: ("diabetes mellitus" OR "type 2 diabetes mellitus" OR "diabetic patients" OR "diabetic foot" OR "diabetic foot ulcer") AND ("peripheral arterial disease" OR "peripheral artery disease" OR "PAD" OR "peripheral vascular disease" OR "chronic limb-threatening ischemia" OR "chronic limb-threatening ischaemia" OR "critical limb ischemia" OR "critical limb ischaemia" OR "CLTI" OR "CLI") AND ("prevalence" OR "epidemiology" OR "frequency" OR "burden") AND ("Indonesia" OR "Indonesian"). Search terms were adapted to each database, and reference lists of eligible studies were screened for additional publications. No restrictions were applied to publication year or language.

Eligibility Criteria

Studies were eligible if they included patients with diabetes mellitus in Indonesia; reported the prevalence of peripheral arterial disease (PAD) or chronic limb-threatening ischemia (CLTI), or provided sufficient data to calculate prevalence; used documented vascular assessment methods, including the ankle-brachial index (ABI), duplex ultrasonography, or clinical examination; and employed observational designs, including cross-sectional, cohort, or case-control studies. Studies reporting critical limb

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ischemia (CLI) were considered for CLTI synthesis when their diagnostic definitions were clinically compatible. Studies were excluded if they involved populations without diabetes, lacked relevant vascular outcomes, provided insufficient data for prevalence estimation, or duplicated previously published datasets.

Data Extraction

Data were extracted using a standardized extraction form. The extracted variables included first author, publication year, study setting, study design, sample size, mean age, sex distribution, diabetes type, vascular assessment method, and the number of participants diagnosed with PAD or CLTI. Prevalence was calculated by dividing the number of affected participants by the corresponding study population. When outcome-specific denominators differed from the total sample size, the reported outcome-specific denominator was used. Studies were categorized according to PAD and CLTI outcomes, and extracted data were examined for completeness and consistency before quantitative synthesis.

Study Quality Appraisal

Methodological quality was assessed using the eight-item Joanna Briggs Institute (JBI) critical appraisal checklist for analytical cross-sectional studies. Each criterion was rated as yes, no, unclear, or not applicable. Quality scores were calculated as the percentage of criteria rated yes, with unclear and no responses assigned zero points. Studies were categorized as good, moderate, or poor according to predefined quality thresholds. The appraisal examined eligibility criteria, participant selection, exposure and outcome measurement, identification and management of confounding factors, and appropriateness of statistical analysis. Methodological quality was summarized descriptively across the included studies.

Statistical Analysis

Separate meta-analyses were performed to estimate the pooled prevalence of PAD and CLTI among patients with diabetes mellitus. Pooled estimates were reported as proportions with 95% confidence intervals (CIs). Between-study heterogeneity was evaluated using Cochran's Q statistic and the I^2 statistic. Meta-regression analyses examined the associations of mean age and male proportion with PAD prevalence, with regression coefficients (β) expressed on the logit scale alongside 95% CIs and p-values. Subgroup analyses were conducted according to study setting (hospital vs community), study design, diabetes type (type 2 vs mixed diabetes), and vascular assessment method (ABI vs duplex ultrasonography). Differences between subgroups were assessed using tests of moderator effects. Potential publication bias was explored using the trim-and-fill method, with the number of imputed studies and adjusted prevalence estimates reported. Statistical significance was defined as a two-sided $p < 0.05$.

Results

Study selection

The literature search identified 270 records, including 250 from four electronic databases and 20 from other sources. After removing 91 duplicates, 159 records were screened, of which 144 were excluded. Fifteen full-text reports were assessed for eligibility, and four were excluded due to unavailable chronic limb-threatening ischemia outcomes. Of the 20 records identified through other sources, eight were not retrieved, and one additional report was eligible for inclusion. Overall, 12 studies were included in the systematic review, comprising six studies on peripheral arterial disease (PAD; n = 6) and six on chronic limb-threatening ischemia (CLTI; n = 6) (Figure 1).

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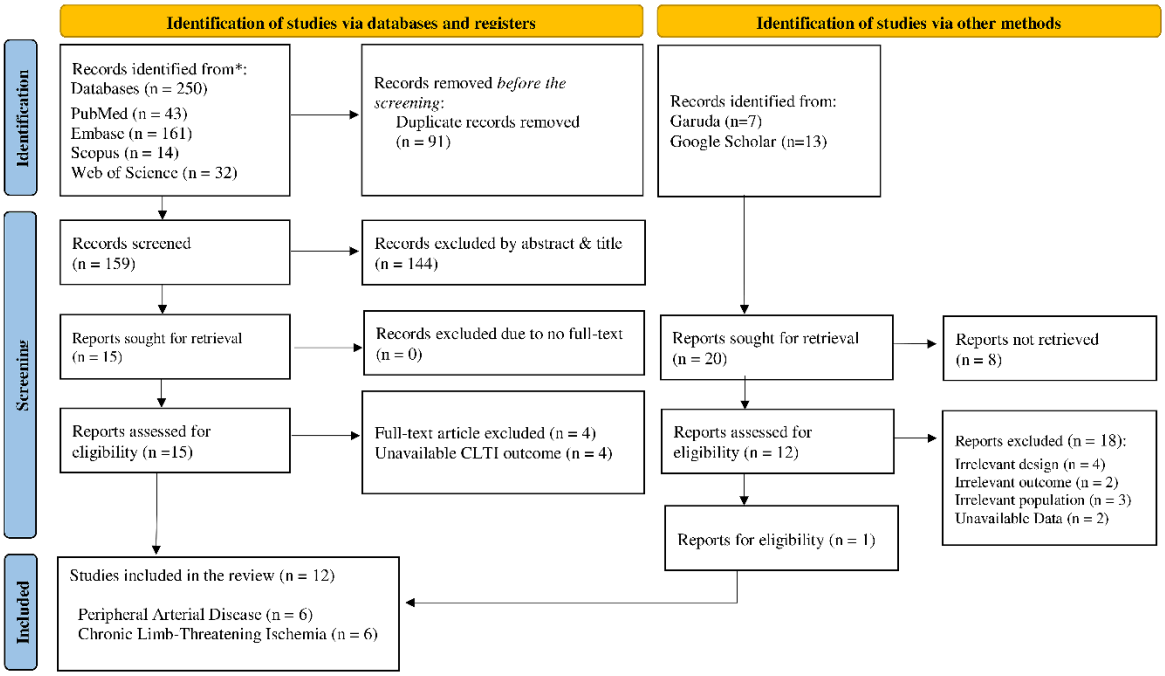

Figure 1. PRISMA Flow Chart

Study characteristics

Author, Year	Setting	Design	Total Sample	Mean Age (Mean ± SD)	Male n (%)	Methods	Prevalence n (%)
Peripheral Arterial Disease (PAD)							
Azkiyah et al., 2015	Hospital	Cross-sectional	54 DM	NR	NR	ABI	18 (33.33)
Ismail et al., 2021	Community	Cross-sectional	256 T2DM	NR	68 (26.6)	ABI	41 (16.02)
Amelia et al., 2021	Community	Cross-sectional	89 T2DM	55.2 ± 8.9	20 (22.5)	ABI	26 (29.21)
Mahmuda et al., 2026	Community	Cross-sectional	65 DM	62.43 ± 9.47	11 (16.9)	ABI	21 (32.31)
Pratiwi et al., 2025	Hospital	Cross-sectional	99 DM	57.00 ± 8.99	43 (43.4)	Duplex USG	55 (55.56)
Fitrianingsih et al., 2025a	Hospital	Retrospective	259 infected DFU	59.65 ± 10.83	124 (47.9)	Duplex USG	133/247 (53.85)
Fitrianingsih et al., 2025b	Hospital	Retrospective	213 DFI	60.27 ± 10.43	99 (46.5)	Clinical Examination	104/203 (51.23)
Chronic Limb-Threatening Ischemia (CLTI)							
Rachmanadi et al., 2021	Hospital	Case-control	74 DM	61.7 ± 11.05	42 (56.8)	Clinical Examination	37(50.00)
Yunir et al., 2022	Hospital	Retrospective cohort	199 T2DM with CLI	62.9 ± 10.1	94 (47.2)	Clinical Examination	199(100)
Effendi et al., 2025	Hospital	Cross-sectional	NR	NR	NR	Clinical Examination	NR
Lianawati et al., 2026	Hospital	Cross-sectional	859 T2DM with DFU	60.98 ± 10.42	389 (45.3)	Clinical Examination	266 (30.97)
Noorsyawal et al., 2020	Hospital	Cross-sectional	41 DFU	NR	NR	Clinical Examination	NR
Dwiputra, 2024	Hospital	Cross-sectional	45 CLTI	NR	NR	Clinical Examination	NR

The 13 studies included 2,253 participants with diabetes mellitus or diabetes-related foot complications, comprising seven peripheral arterial disease (PAD) studies (n = 1,035) and six chronic

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limb-threatening ischemia (CLTI) studies (n = 1,218, excluding one study with an unreported sample size). Ten studies were hospital-based, and three were community-based. Study designs included nine cross-sectional studies, three retrospective studies, and one case-control study. The sample-size-weighted mean age, calculated from studies reporting age, was 59.17 years for PAD (five studies; n = 725) and 61.36 years for CLTI (three studies; n = 1,132). PAD prevalence ranged from 16.02% to 55.56% across seven studies, while reported CLTI proportions ranged from 30.97% to 100% across three studies. PAD was assessed using the ankle-brachial index, duplex ultrasonography, or clinical examination, whereas all CLTI studies reported clinical examination (Table 1).

Pooled prevalences of PAD and CLTI

Table 2. Pooled prevalences of PAD and CLTI in patients on DM

Outcome	No. of studies	Pooled prevalence	95% CI	Q	*p*	I^2 (%)
PAD	7	0.25	0.25 to 0.50	90.843	<0.001	93.39
CLTI	3	0.61	0.31 to 0.84	33.251	<0.001	93,98

Abbreviation:

The pooled prevalence of peripheral arterial disease (PAD) was 25% (95% CI, 25%–50%) across seven studies, with substantial heterogeneity (Q = 90.843; I^2 = 93.39%; p < 0.001). For chronic limb-threatening ischemia (CLTI), the pooled prevalence was 61% (95% CI, 31%–84%) across three studies, with similarly high heterogeneity (Q = 33.251; I^2 = 93.98%; p < 0.001). Both estimates showed considerable between-study variability (Table 2; Figure 2; Figure 3).

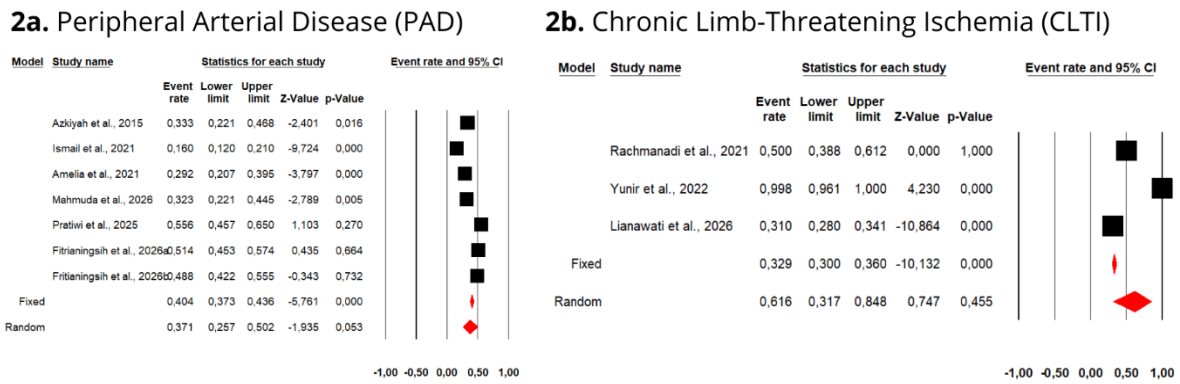

Figure 2. Forest plot prevalences of

Moderator analysis

Peripheral Arterial Disease (PAD)

Meta-regression showed that male proportion was significantly associated with PAD prevalence (β = 0.042; 95% CI, 0.011–0.728; p = 0.007), whereas mean age was not (β = 0.012; 95% CI, −0.151 to 0.175; p = 0.884). Subgroup analyses identified significant differences by study setting (p = 0.002), study design (p = 0.040), diabetes type (p = 0.008), and assessment method (p < 0.001). PAD prevalence was higher in hospital-based than community-based studies (48% vs 24%), in case-control than cross-sectional studies (50% vs 32%), and in mixed diabetes populations than exclusively type 2 diabetes populations (45% vs 21%). Studies using duplex ultrasonography reported higher prevalence than those using the ankle-brachial index (50% vs 26%) (Table 3).

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Table 3. Moderator analysis

Variable	PAD			
	n	β (logit) [95% CI]	p^1	p^2
Age (years)	5	0.012 [-0.151 to 0.175]	0.884	
Male (%)	6	0.042 [0.011 to 0.728]	0.007	
Study Setting				0.002
Hospital	4	0.48 [0.42 to 0.55]	0.077	
Community	3	0.24 [0.15 to 0.37]	0.375	
Study Design				0.040
Cross-sectional	5	0.32 [0.18 to 0.48]	0.488	
Case-control	2	0.50 [0.45 to 0.54]	0.547	
Types of Diabetes				0.008
T2DM	2	0.21 [0.11 to 0.37]	0.370	
MIXDM	5	0.45 [0.38 to 0.53]	0.533	
Measure				<0.001
ABI	4	0.26 [0.17 to 0.37]	<0.001	
Duplex USG	2	0.50 [0.45 to 0.54]	0.927	

Quality of Study

Of the 12 studies assessed, six were rated as good, six as moderate, and one as poor quality. Fitrianingsih et al. (2025b) was the only poor-quality study (37.5%), primarily due to unclear eligibility criteria, inadequate identification and control of confounding factors, and insufficient reporting of outcome measurement and statistical analysis (Table 4).

Table 4. Methodological quality appraisal Cross-Sectional Study: PAD and CLTI

Study ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Scores (%)	Results
Azkiyah et al., 2015	Y	Y	U	Y	U	U	Y	U	50.0	Moderate
Ismail et al., 2021	Y	Y	Y	Y	Y	U	Y	U	75.0	Good
Amelia et al., 2021	Y	Y	Y	Y	U	U	Y	U	62.5	Moderate
Mahmuda et al., 2026	Y	Y	Y	Y	U	U	Y	U	62.5	Moderate
Pratiwi et al., 2025	Y	Y	Y	Y	U	U	Y	U	62.5	Moderate
Fitrianingsih et al., 2025	Y	Y	U	U	Y	Y	U	Y	62.5	Moderate
Rachmanadi et al., 2021	Y	Y	Y	Y	Y	U	Y	U	75.0	Good
Yunir et al., 2022	Y	Y	Y	Y	Y	U	Y	U	75.0	Good
Effendi et al., 2025	Y	Y	Y	Y	Y	U	Y	U	75.0	Good
Lianawati et al., 2026	Y	Y	U	U	Y	Y	U	Y	62.5	Good
Noorsyawal et al., 2020	Y	Y	Y	Y	Y	U	Y	U	75.0	Good
Dwiputra, 2024	Y	Y	U	U	Y	U	U	Y	50.0	Moderate

Publication Bias

The trim-and-fill analysis identified no missing studies for either peripheral arterial disease (PAD) or chronic limb-threatening ischemia (CLTI). The adjusted prevalence estimates were 40% (95% CI, 37%–43%) for PAD and 30% (95% CI, 28%–33%) for CLTI. These findings indicated no funnel plot asymmetry detected by the trim-and-fill method (Table 5).

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Table 5. Publication bias

Method	PAD	CLTI
Trim & Fill method		
Missing studies	0	0
Adjusted prevalence	0.40 (0.37 to 0.43)	0.30 (0.28 to 0.33)

Abbreviations: CI, confidence interval; DPN, PAD, peripheral arterial disease; CLTI, chronic limb-threatening ischemia

Discussions

This systematic review and meta-analysis examined the prevalence of peripheral arterial disease (PAD) and chronic limb-threatening ischemia (CLTI) among patients with diabetes mellitus in Indonesia. The findings indicated a substantial burden of lower-extremity vascular complications, with a pooled PAD prevalence of 25% and CLTI prevalence of 61%. Considerable heterogeneity was observed for both outcomes (I^2 = 93.39% and 93.98%, respectively), suggesting substantial variation across study populations and clinical settings. Meta-regression identified a significant association between male proportion and PAD prevalence, while subgroup analyses revealed significant differences according to study setting, design, diabetes type, and vascular assessment method. This review extends existing evidence by examining PAD and CLTI separately within the Indonesian diabetes population and identifying study-level factors associated with variation in prevalence. These findings highlight the importance of context-specific vascular assessment and early identification of patients at risk of limb-threatening complications.

The differences in PAD prevalence across study settings and assessment methods warrant particular attention. Hospital-based studies reported higher prevalence than community-based studies (48% vs 24%), potentially reflecting the greater clinical complexity and burden of diabetic foot complications among hospitalized patients. Studies using duplex ultrasonography also reported higher prevalence than those using the ankle-brachial index (50% vs 26%). This difference may reflect variation in diagnostic sensitivity, arterial calcification, and the characteristics of patients selected for vascular imaging. In patients with diabetes, medial arterial calcification can produce falsely elevated ankle pressures, potentially limiting the diagnostic accuracy of ABI alone (Fitridge et al., 2024). These findings support combining clinical assessment with appropriate vascular testing, particularly among patients with diabetic foot ulcers or suspected ischemia. However, differences in diagnostic methods and clinical settings should be interpreted as study-level associations rather than evidence of causality.

The pooled PAD prevalence in this review was higher than the global estimate of 19% reported by Burhan et al. (2026), but was comparable to the 24% estimate reported for developing countries. This pattern suggests that the vascular burden among Indonesian patients with diabetes may resemble that observed in other resource-constrained settings, although differences in study populations and diagnostic criteria limit direct comparisons. In an Indonesian multicenter cohort of 620 patients with diabetic foot ulcers, Burhan et al. (2025) reported PAD in 41.9% of participants and an association between PAD and poorer amputation-free survival and wound healing. Similarly, Haruka et al. (2025) reported that higher transcutaneous oxygen pressure was associated with improved healing probability among patients with CLTI. These findings are consistent with the clinical relevance of impaired lower-extremity perfusion. The present synthesis adds evidence that variation in patient selection and diagnostic assessment may contribute substantially to differences in vascular prevalence estimates across studies.

The main strength of this review was its synthesis of Indonesian evidence on two clinically important vascular complications, supported by subgroup analyses, meta-regression, and methodological quality appraisal. Nevertheless, several limitations affect interpretation. Substantial heterogeneity reduced the precision and comparability of pooled estimates, while differences in PAD and CLTI definitions may have introduced outcome misclassification. The CLTI analysis included only three studies, limiting the reliability of its pooled estimate and the ability to assess small-study effects. Most included studies were hospital-based, potentially overrepresenting patients with advanced disease. Moreover, study-level moderator analyses are vulnerable to ecological bias and cannot

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establish individual-level associations or causality. Consequently, the findings may not fully represent the broader Indonesian population with diabetes, particularly individuals receiving care in primary healthcare settings.

These findings have implications for vascular screening, diabetic foot management, and limb-salvage services in Indonesia. Clinicians should consider systematic assessment of peripheral perfusion in patients with diabetes, especially those presenting with foot ulcers, suspected ischemia, or delayed wound healing. Current international guidelines recommend combining ABI, toe-brachial index, and pedal Doppler waveforms when PAD is suspected, rather than relying on a single diagnostic measure (Fitridge et al., 2024). At the healthcare-system level, improved access to vascular assessment and coordinated referral pathways may support earlier recognition of limb-threatening disease. Future multicenter studies should apply standardized PAD and CLTI definitions, include community-based populations, and report consistent vascular assessment outcomes. Such approaches may improve the accuracy of national prevalence estimates and inform context-appropriate diabetes-related limb preservation strategies.

Strengths and Limitations of the Study

This review provides a country-specific synthesis of PAD and CLTI prevalence among Indonesian patients with diabetes, incorporating subgroup analyses, meta-regression, and methodological quality assessment. However, substantial between-study heterogeneity and variations in diagnostic criteria may have affected the precision of pooled estimates. Hospital-based sampling may have overestimated prevalence relative to the general diabetes population, while the limited number of CLTI studies restricted statistical reliability. Inconsistent outcome reporting and potential residual confounding further limited interpretation. Meta-regression findings represent study-level associations and should not be interpreted as individual-level risk factors. Accordingly, these results should be interpreted cautiously, particularly when informing national screening policies and clinical resource allocation.

Implications for Nursing Practice

The findings emphasize the importance of vascular assessment in diabetes nursing care, particularly for patients with foot ulcers and suspected ischemia. Nurses should routinely assess peripheral pulses, skin temperature, wound characteristics, and signs of impaired perfusion, with ABI, toe pressure, or Doppler assessment arranged when clinically indicated. Nursing teams may benefit from standardized vascular screening protocols, structured documentation, and clear referral pathways for suspected PAD or CLTI. Patient education should emphasize daily foot inspection, early reporting of nonhealing wounds, and timely medical evaluation. These strategies may support earlier recognition of vascular complications and more coordinated limb-preservation care.

Implications for Clinical Practice

The substantial prevalence estimates and marked between-study variation highlight the need for standardized vascular assessment among patients with diabetes in Indonesia. Clinicians should consider combined ABI, toe-brachial index, and Doppler waveform assessment, particularly when arterial calcification or diabetic foot ulceration limits the interpretation of ABI alone (Fitridge et al., 2024). Patients with rest pain, gangrene, nonhealing ulcers, or severe perfusion abnormalities warrant timely vascular evaluation and consideration of revascularization. Healthcare institutions may consider integrating vascular assessment into multidisciplinary diabetic foot pathways to improve diagnostic consistency and referral efficiency. These approaches may strengthen limb-salvage services, although their effectiveness in Indonesian healthcare settings requires further evaluation.

Conclusion

PAD and CLTI represent substantial vascular complications among patients with diabetes in Indonesia, with considerable variation in prevalence across studies. Differences in clinical setting, diabetes type, study design, and vascular assessment method were associated with PAD prevalence, highlighting the importance of standardized diagnostic approaches. Improved vascular screening and larger, methodologically consistent population-based studies are needed to refine prevalence estimates and inform diabetes-related limb-preservation strategies.

Acknowledgments

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Conflicts of Interest

The authors declare no competing financial or nonfinancial interests related to this study.

Author Contributions

Asmat Burhan conceptualized the study, developed the methodology, and performed the statistical analysis. Indah Susanti contributed to literature screening, data extraction, and methodological appraisal. Bubacarr Jabbie contributed to data interpretation and critical manuscript revision. All authors reviewed and approved the final manuscript and accept responsibility for its integrity.

Data Availability Statement

The data supporting this systematic review and meta-analysis are available from the corresponding author, Asmat Burhan, upon reasonable request, subject to applicable data-sharing and research integrity requirements.

Declaration of Generative AI and AI-Assisted Technologies

Generative AI and AI-assisted technologies were not used in the preparation of this manuscript. The authors retain full responsibility for the content.

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