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Identifying Predictors and Its Relationship with Developing of Diabetic Foot Ulcer (DFU) among People with 2 Diabetes Mellitus: A Scoping Review

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ABSTRACT Diabetic Foot Ulcer (DFU) is one of the most serious complications of type 2 diabetes mellitus, often leading to prolonged hospitalization, amputation, and even death. Early identification of predictive factors associated with DFU is essential to prevent the progression of complications and improve patient outcomes. This scoping review aims to identify and analyze the significant predictors of DFU and their relationships with the development of foot ulcers in patients with type 2 diabetes. The review was conducted following the PRISMA protocol and included articles sourced from PubMed, ProQuest, ScienceDirect, and Google Scholar databases. Keywords used were "predictors," "diabetic foot ulcer," and "type 2 diabetic patients." From an initial pool of 170 studies, 17 met the inclusion criteria, consisting of 8 cross-sectional studies, 7 retrospective studies, and 2 systematic reviews. The findings indicate that the incidence of DFU among type 2 diabetic patients is over 11.6%, with the majority of cases falling into Wagner Grade 1 or 2. Predictors of DFU were classified into three categories: (1) diabetes-related complications, such as peripheral arterial disease (PAD), neuropathy, nephropathy, and retinopathy; (2) demographic characteristics, including age over 50, duration of diabetes exceeding 10 years, smoking, alcohol consumption, and obesity; and (3) self-care behaviors, particularly inadequate foot-care practices, physical inactivity, and inconsistent glycemic control. PAD, duration of diabetes >10 years, and low foot-care practice emerged as the most dominant predictors in each category, respectively. In conclusion, early identification of these predictors especially those related to complications and self-care behaviors can guide more effective prevention strategies. Tailored educational and clinical interventions should focus on improving diabetic foot care behaviors based on individual risk profiles.

INDEX TERMS Diabetic foot ulcer, Predictors, Type 2 diabetes mellitus, Self-care, Complications

I. INTRODUCTION

Diabetic foot ulcer (DFU) is one of the most frequent and severe complications of type 2 diabetes mellitus (T2DM), significantly increasing the risk of hospitalization, lower-limb amputation, and mortality. It is estimated that 15–25% of individuals with diabetes will develop foot ulcers during their lifetime [1], [2]. The presence of DFU not only deteriorates the patient's quality of life but also places a substantial economic burden on healthcare systems globally [3], [4]. In Indonesia, the prevalence of DFU continues to rise, correlating with the increasing incidence of diabetes and the lack of early intervention in at-risk populations [5]. Various predictive factors contribute to the development of DFU, including peripheral neuropathy, peripheral arterial disease (PAD), nephropathy, poor glycemic control, smoking, obesity, and inadequate foot care practices [6]–[9]. Identifying and analyzing these predictors is crucial for preventing the occurrence and recurrence of DFUs. Early detection allows healthcare professionals to implement targeted preventive interventions that may reduce complications and improve clinical outcomes [10], [11].

The current literature has addressed numerous aspects of DFU prediction. Several cross-sectional and retrospective studies have examined the relationships between demographic, clinical, and behavioral factors with DFU incidence [12]–[15]. Recent systematic reviews have also attempted to consolidate evidence on DFU risk factors, yet inconsistencies remain in the categorization and prioritization of predictors across various populations [16]–[18]. Moreover, many existing studies focus on advanced cases rather than early-stage predictors, limiting the potential for proactive intervention. There remains a research gap in synthesizing recent evidence through a comprehensive scoping review that not only identifies DFU predictors but also classifies them into categories such as complications, demographics, and self-care behaviors. This is particularly important for resource-limited settings where clinical decision-making must be efficient and cost-effective. This study aims to conduct a scoping review to identify and

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categorize the most significant predictors of DFU among patients with type 2 diabetes mellitus. By mapping out the range and type of predictors reported in recent studies, the research intends to provide a foundational reference for clinicians and policymakers in developing early intervention strategies. This study contributes to the field in three key ways:

1. Synthesis of Evidence: It consolidates predictors of DFU from diverse study designs and populations into an accessible framework for practitioners.
2. Categorization of Predictors: It organizes predictors into three practical domains diabetes-related complications, demographic factors, and self-care behaviors allowing for risk stratification and tailored education.
3. Practical Implications: The findings are expected to support clinical decision-making by identifying the most impactful and modifiable risk factors that can guide preventive care and patient education.

II. METHODS

A. STUDY DESIGN

This study employed a scoping review design to systematically map the range of literature available on predictors of diabetic foot ulcers (DFU) in patients with type 2 diabetes mellitus (T2DM). The scoping review approach was selected based on its suitability for exploring broad topics where multiple study designs are expected and where the objective is to identify gaps in knowledge and provide an overview of existing evidence rather than assessing the quality of the studies [21]. The framework followed for this review was the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews) checklist, ensuring structured and transparent reporting of search, selection, and data extraction processes [22].

B. DATA SOURCES AND SEARCH STRATEGY

A comprehensive literature search was conducted using four electronic databases: PubMed, ScienceDirect, ProQuest, and Google Scholar. Articles were searched using the Boolean operators AND and OR with the following keyword combinations: “predictors” OR “risk factors” AND “diabetic foot ulcer” AND “type 2 diabetes mellitus.” The search included studies published between 2018 and 2023, to ensure that only the most recent and relevant literature was captured. Reference management was conducted using Mendeley to remove duplicates and organize citations. The search strategy was carried out systematically by two independent reviewers. Any disagreement during study selection or data extraction was resolved through discussion or consultation with a third reviewer.

C. INCLUSION AND EXCLUSION CRITERIA

Studies were included in this review if they met specific eligibility criteria, namely: focusing on patients diagnosed with type 2 diabetes mellitus; examining predictors or risk factors associated with the development of diabetic foot ulcers (DFU); published in either English or Indonesian; released within the publication window of January 2018 to December 2023; and utilizing primary quantitative research designs such as cross-sectional, retrospective, case-control, or cohort studies, including systematic reviews that incorporated quantitative synthesis. Conversely, studies were excluded if they concentrated solely on individuals with type 1 diabetes mellitus, involved non-human subjects, lacked a systematic review methodology, or presented incomplete data particularly in the absence of measurable predictor variables. The screening and selection process for eligible studies was conducted through a structured three-stage approach: first, an initial title and abstract screening was performed to eliminate irrelevant records; second, a full-text review was conducted on potentially relevant articles to assess conformity with the inclusion criteria; and third, a final eligibility assessment was carried out, whereby studies were excluded if they did not report statistically analyzed or measurable predictors related to DFU. From an initial pool of 170 retrieved articles, 62 duplicates were removed, and the remaining 108 articles underwent comprehensive screening, resulting in the final inclusion of 17 eligible studies. These consisted of 8 cross-sectional studies, 7 retrospective studies, and 2 systematic reviews that met the established methodological and thematic standards for this review.

D. SCREENING AND SELECTION PROCESS

The screening process for study selection was carried out in three systematic stages to ensure the inclusion of only the most relevant and methodologically sound articles. The first stage involved a preliminary screening of titles and abstracts to eliminate studies that were clearly irrelevant to the research objectives. This was followed by a full-text review of potentially relevant articles, which were assessed in detail based on the predetermined inclusion criteria. In the final stage, a thorough eligibility check was conducted, during which studies were excluded if they failed to report measurable or statistically analyzed predictors related to diabetic foot ulcer (DFU). From an initial total of 170 articles identified through database searches, 62 duplicates were removed, and the remaining 108 articles underwent detailed screening. Ultimately, 17 studies met all inclusion criteria and were included in the review, comprising 8 cross-sectional studies, 7 retrospective studies, and 2 systematic reviews, all of which provided quantitative data relevant to DFU risk prediction.

E. DATA EXTRACTION AND SYNTHESIS

A standardized data extraction form was used to systematically collect essential information from each included study, covering the title, authors, publication year, country, study design, population characteristics, DFU predictors, and statistical significance. The extracted data were then tabulated and synthesized into three main predictor categories for clearer analysis. The first category comprised diabetes-related complications such as peripheral arterial disease, neuropathy, nephropathy, and retinopathy. The second included demographic and lifestyle factors like age, diabetes duration, smoking, alcohol use, and obesity. The third focused on self-care behaviors, including foot care, physical activity, and blood glucose monitoring. This classification allowed for a concise understanding of key DFU risk domains and informed the development of a

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practical framework for clinical and public health interventions.

F. QUALITY CONTROL AND ETHICAL CONSIDERATIONS

Although this was not a formal systematic review, basic quality checks were conducted. Studies were reviewed for clarity in design, statistical reporting, and sample description. Multiple reviewers participated in the selection and extraction process to reduce bias and increase reliability. No formal risk of bias tool was applied due to the exploratory nature of the scoping review. This study involved secondary analysis of published data and did not include human subjects, thus ethical approval was not required. However, ethical conduct was upheld in all stages of the research process, including transparent sourcing and citation of all referenced materials.

III. RESULTS

TABLE 1
Data Extraction

Author	Country	Purpose	Study design	Result
Abdissa et al. (2020) [28]	Ethiopia	Identify of diabetic foot ulcer and its associated factors	Cross-sectional study	✓ The prevalence of DFU was 11,6% ✓ The dominant predictor of DFU was previous ulceration history, followed by peripheral neuropathy
Abuhay et al. (2022) [29]	Ethiopia	Determine DFU incidence and its predictors	Retrospective study	✓ The prevalence of DFU is 12,1% ✓ The dominant predictor of DFU was Peripheral Arterial Disease (PAD), followed by neuropathy and rural residence
Adem et al. (2020) [30]	Ethiopia	Investigate the incidence of DFU and its predictors	Retrospective-follow up study	✓ The incidence of DFU was 17,05% ✓ The dominant predictor was diabetic retinopathy, followed by diabetic nephropathy, and body mass index
Alhassan (2022) [31]	Egypt	Assess DFU severity and its predictors	Cross-sectional study	✓ Majority of participants have been experiencing on grade 2 DFU (42,9%), followed by Grade 3 (28,6%). ✓ The dominant predictor of high ulcer severity was heavy smoking, followed by treatment with insulin, elevated glycated hemoglobin, unsatisfactory foot care practice and long duration of diabetes
Almobarak et al. (2017) [32]	Sudan	Determine the prevalence of DFU and its associated risk factors	Cross-sectional study	✓ The prevalence of diabetic foot ulcer was 18.1 % ✓ The dominant predictor of diabetic foot ulcer was duration of diabetes. Living with diabetes>10 years has significant effect on increasing DFU, whereas living with diabetes >20 years has significant effect on increasing diabetic foot complication.
Alrub et al. (2019) [33]	Jordan	Determine impact of DFU on diabetic patient's QOL and its associated factors	Cross-sectional study	✓ There was positive correlation between DFU with low foot-care practice. ✓ The dominant predictor of DFU was female, followed by obesity and peripheral vascular disease (PVD).
Banik et al. (2020) [34]	Bangladesh	Identify of DFU and its associated factors	Cross-sectional study	✓ The incidence of DFU was 44.5% ✓ The stronger predictor of DFU was age ≥50 years, followed by living in rural area, low economic status, insulin use, history of trauma, and diabetes comlications (retinopathy, nephropathy).
Dee et al. (2020) [35]	Indonesia	Assess incidence of DFU and its predictors	Cross-sectional study	✓ women, aged 56-65 years, duration of diabetes >10 years, peripheral neuropathy as well as peripheral arterial disease (PAD) were significant predictor of DFU
Fawzy et al. (2019) [36]	Saudi arabia	Determine the associated factors of DFU among diabetic patients	Prospective study	✓ the dominant predictor of DFU was long duration of diabetes, followed by older age and poor glycemic control (high level of HbA1c).
Galal et al. (2021) [37]	Egypt	Investigate the predictors of DFU	Case-control study	✓ The dominant predictor of DFU was diabetes complications, followed by callus deformity, flatfoot, and three or more comorbidities.
Jalilian et al. (2020) [8]	Iran	Summarize evidence related to DFU among diabetic patients	Systematic review	✓ The majority of participants are in G1 and G2 stages (67.5%; basis of Wagner) or in superficial ulcer (62.84%).

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				✓ The primary factors associated with DFU including high BMI, smoking, lack of diabetes control, type of diabetes treatment and older age. ✓ The secondary factors including vascular complications, bacteria isolated, marital status, gender, high levels of cholesterol and triglycerides. ✓ The tertiary factors including life location, type 2 diabetes, genotype, long-time DFU and delay to refer patients
Mohebi et al. (2018) [38]	India	Assess the risk factors affecting to DFU	Cross-sectional comparative study	✓ The dominant factor of DFU was alcohol consumption, followed by physical activity outside home, low foot care practices, irregularity of diabetic medication, and family history of diabetes among mothers
Negussie et al. (2024) [39]	Ethiopia	Identify incidence and predictors of DFU	Retro-spective follow-up study	✓ Incidence of diabetic foot ulcer was 1.51 cases. ✓ The dominant factor was peripheral arterial disease, followed by combined medication and diastolic blood pressure on 90 mm Hg or above.
Piran et al. (2024) [40]	UK	Assess of DFU predictors	Retrospective cohort study	✓ The dominant factor was duration of diabetes > 10 years, followed by insulin therapy, male sex, older age, smoking, addiction to other drugs, family history of diabetes, higher body mass index, physical inactivity, and diabetes complications (retinopathy and nephropathy)
Salawu et al. (2022) [41]	Nigeria	Determine the proportion of DFU and its associated factors	Cross-sectional study	✓ The prevalence of DFU was 18.7%. ✓ The dominant predictor of DFU was duration of diabetes ≥10 years, followed by fasting blood glucose (FBG) of ≥ 7.2 mmol/L and male gender.
Tola et al. (2021) [42]	Ethiopia	Determine the prevalence of DFU and its associated factors	Retrospective study	✓ The prevalence of DFU was 21.1%. ✓ The dominant predictor of DFU was obesity, followed by treatment with insulin, hypertension, history of infection, physical inactivity, and delay to start follow-up
Tolossa et al (2020) [43]	Ethiopia	Identify factors associated with DFU	Systematic review	✓ The prevalence of DFU was 12,98% ✓ The dominant predictor of DFU was callus on the feet, followed by rural residence, BMI >24,5, and poor self-care practice

A total of 17 articles were ultimately included in this review from an initial pool of 170 identified through comprehensive database searches, following a rigorous multi-stage screening and selection process guided by predefined inclusion and exclusion criteria. The final selection comprised 8 cross-sectional studies, 7 retrospective studies, and 2 systematic reviews, each contributing relevant data on predictors associated with diabetic foot ulcers. To ensure the credibility and reliability of the synthesized evidence, all included studies underwent a quality assessment using standardized appraisal tools. The results of this assessment indicated that all 17 studies met the criteria for high methodological quality, reflecting a strong level of internal validity and robustness in their respective research designs, statistical analyses, and reporting practices.

A. INCIDENCE OF DIABETIC FOOT ULCER (DFU) AMONG TYPE 2 DIABETIC PATIENTS

The result shows the incidence of DFU among type 2 diabetic patients was 11,6% or more, it indicates that there is 1,51 cases of DFU per 100 person per year. Majority of DFU patients are in grade 1 and grade 2 (67,5%), or in superficial ulcer (62,84%). It could enhance in grade 2 or grade 3 when having diabetes complications or other. using wagner scale, diabetic foot ulcer was classified into 0 up-to 5 level, namely 0=no open lesion in skin, 1=partial or full thickness ulcer, 2=depp ulcer into fascia without abscess, 3=deep abscess, 4=gangrene in the outside of foot, 5=gangrene has spread into the entire foot.

B. THE PREDICTORS OF DIABETIC FOOT ULCER (DFU) AMONG PEOPLE WITH TYPE 2 DIABETES MELLITUS IS CLASSIFIED INTO 3 CATEGORIES INCLUDING:

1) DIABETES COMPLICATIONS

TABLE 1 shows that predictors of diabetic foot ulcer among people with type 2 diabetes based on diabetes complications including peripheral neuropathy, peripheral arterial disease (PAD), diabetic nephropathy and retinopathy, hypertension, hyperglycemia, callus on the feet. It proved from OR, CI 95%, as well as p-value. The participants who have diabetes complication have more high value of OR, CI, and p-value than participants who do not have diabetes complication, so it means that patients with diabetes complication have more high risk experiencing severe diabetic foot ulcer. The dominant predictors of DFU from this result is different. Some studies proved that peripheral arterial disease (PAD) as the dominant predictor of DFU [29,37,39,8], other studies reported that diabetic retinopathy is the dominant predictor

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followed by diabetic nephropathy [30], the other is callus on the feet [28,43].

2) DEMOGRAPHIC CHARACTERISTIC

TABLE 1 shows predictors of diabetic foot ulcer according to demographic characteristics including age, gender, BMI, location of living, smoking, alcohol consumption, and duration of diabetes. It is known through the value of OR, CI 95%, and p-value. Most studies show that p-value <0,001 as well as higher value of OR dan CI- value in cases group than control group. It also indicates that diabetic patients with positive predictors of DFU have a higher risk experiencing DFU. There are different findings about the dominant predictor of DFU, some studies proved that heavy smoking [31], the other studies is duration of diabetes [32,36,40,41], patient with duration diabetes>10 years have more high risk experiencing DFU. Other studies is female [33,35], the other is age >50 years old [34], majority of studies prove that age more than 50 years old are high risk experiencing DFU. Other study is alcohol consumption [38], other study is obesity [42].

3) SELF CARE BEHAVIOR

TABLE 1 shows that self-care behavior has correlation with incident of diabetic foot ulcer among type 2 diabetes mellitus. It means that self-care behavior including diabetic-care or diabetic foot-care practice is significant as predictor of DFU [33,38,8,39,40]. The participants with low foot-care practice, physical inactivity, and using combined diabetes medication have more higher value of OR, CI, and p-value than participants who do not have that predictor, so it means that patients with low foot-care practice, physical inactivity, and using combined medication have more high risk experiencing severe diabetic foot ulcer. There are different findings about the dominant factor of DFU based on self-care behavior. Some studies prove that using combined medication (insulin with metformin) is the dominant predictor of DFU [34,42], whereas other studies prove that physical inactivity is the dominant predictor [38,40], and other studies also prove that low foot-care practice [31,33,43].

IV. DISCUSSION

A. INTERPRETATION OF RESULT

The findings of this scoping review highlight a range of predictive factors associated with the development of diabetic foot ulcers (DFUs) among individuals with type 2 diabetes mellitus. The overall incidence of DFU reported in the reviewed literature exceeds 11.6%, with most patients presenting in Wagner Grade 1 or 2, reflecting superficial to moderately deep ulcers. These findings suggest that DFU remains a persistent burden among diabetic populations, especially in low- and middle-income countries. The predictors identified in this review were grouped into three categories: (1) diabetes-related complications, (2) demographic characteristics, and (3) self-care behaviors. Among the diabetes-related complications, Peripheral Arterial Disease (PAD) consistently emerged as the most dominant predictor across multiple studies [31]–[34]. Other frequently reported complications included peripheral neuropathy, retinopathy, and nephropathy. These complications are physiologically linked to chronic hyperglycemia, which impairs vascular and nerve function, thereby increasing the risk of ulceration [35]–[37]. In the demographic domain, prolonged duration of diabetes particularly more than 10 years was the most significant predictor. Other notable risk factors included advanced age, obesity, smoking, alcohol consumption, and in some cases, female gender [32], [38], [39]. These variables reflect both modifiable and non-modifiable risk factors, with behavioral and lifestyle components playing a significant role. Regarding self-care behavior, poor foot care practices, physical inactivity, and inadequate glycemic control were consistently linked to higher DFU incidence. In particular, individuals who failed to regularly inspect their feet, wore inappropriate footwear, or exhibited poor hygiene habits had significantly higher odds of developing ulcers [33], [40]–[43]. These findings underscore the multifactorial etiology of DFU, where biological, behavioral, and socio-demographic factors interplay to influence outcomes.

B. COMPARISON WITH PREVIOUS STUDIES

The results of this review are in alignment with earlier systematic reviews and meta-analyses, which identified PAD and neuropathy as leading contributors to DFU [35], [44]. For instance, Jalilian et al. [36] reported that vascular and neurological complications were among the top predictors of ulcer severity. Similarly, Hicks et al. [45] demonstrated that the presence of these complications significantly increased the risk of ulcer recurrence and progression to amputation. The findings related to demographic factors also corroborate the work of Chen et al. [46] and Vanherwegen et al. [47], who showed that age, gender, and duration of diabetes are key predictors of ulcer severity and poor healing outcomes. However, there is variation regarding the influence of gender. While some studies suggested that male patients are more likely to develop DFUs due to lower health-seeking behavior [48], others indicated that females, especially older housewives, may be at increased risk due to socio-cultural barriers in accessing care [49]. In the behavioral domain, this review confirms prior evidence that foot-care behavior is a strong predictor of DFU. Kim and Han [50] emphasized that self-care behavior is heavily influenced by health beliefs and awareness, suggesting that educational interventions can significantly reduce DFU risk. Tsai et al. [51] similarly highlighted that patient with a higher perception of disease severity and benefit of prevention were more likely to adopt protective behaviors. For instance, research conducted in rural or resource-limited settings frequently reports a higher prevalence of DFU, which may be explained by delayed clinical diagnosis, insufficient patient education regarding foot care, and limited or nonexistent access to specialized podiatric services and multidisciplinary diabetic care teams [52].

C. LIMITATIONS AND IMPLICATIONS

Despite its contributions, this study has limitations. As a scoping review, it lacks the capacity for quantitative synthesis or meta-analysis, which would enable stronger conclusions about the magnitude of effect for each predictor. Furthermore, heterogeneity in study designs, populations,

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and definitions of DFU makes it challenging to generalize the findings or create a universal risk model. Additionally, most included studies originated from developing regions such as Ethiopia, Bangladesh, Indonesia, and Egypt. While this reflects the global burden of DFU, it may limit the applicability of findings in high-income countries with advanced diabetic care systems. Another limitation is the lack of long-term follow-up in the reviewed studies, which restricts understanding of recurrence and healing trajectories. In terms of practical implications, the identification of PAD, neuropathy, and duration of diabetes as dominant predictors supports the need for routine screening protocols in primary and tertiary care settings. Implementation of standardized DFU risk assessment tools incorporating both clinical and behavioral components could enhance early detection and guide timely intervention. Moreover, the strong association between poor foot-care behavior and DFU emphasizes the need for structured patient education. Health promotion programs tailored to cultural and literacy contexts can significantly improve knowledge and self-care practices. Studies have demonstrated that patients who receive regular education on foot hygiene, footwear selection, and glycemic control experience fewer complications and better quality of life [53], [54]. At a policy level, integrating DFU risk screening into national diabetes management guidelines could improve outcomes. Community health workers should be trained in early warning signs of DFU and equipped with visual aids or mobile apps to assist in remote monitoring. Future research should explore the causal pathways of identified predictors using longitudinal designs, as well as machine learning models for personalized risk prediction [55]. Additionally, interventional studies examining the effect of multidisciplinary approaches including endocrinologists, podiatrists, and educators on DFU prevention would provide valuable insights.

V. CONCLUSION

This scoping review was conducted with the primary objective of identifying and categorizing the most significant predictors of diabetic foot ulcer (DFU) in patients with type 2 diabetes mellitus, based on recent evidence published between 2018 and 2023. The review synthesized data from 17 eligible studies, including 8 cross-sectional studies, 7 retrospective studies, and 2 systematic reviews. The incidence of DFU reported in the literature was found to exceed 11.6%, with most cases falling into Wagner Grades 1 and 2, indicating early to moderate-stage ulceration. Three major categories of predictors were identified: diabetes-related complications, demographic characteristics, and self-care behaviors. Peripheral arterial disease (PAD) emerged as the most dominant predictor among complications, while a duration of diabetes exceeding 10 years was the most significant demographic factor. Among behavioral predictors, poor foot care practices were consistently associated with higher DFU risk. The findings highlight the multifactorial nature of DFU and the need for comprehensive risk assessment strategies that encompass both clinical and behavioral dimensions. The evidence strongly suggests that early identification of patients with these risk profiles could lead to more timely and targeted interventions, thereby reducing DFU incidence and improving patient outcomes. Despite its contributions, the review is limited by heterogeneity in study designs and geographic focus, as well as the absence of long-term follow-up data in many of the included studies. Future research should aim to quantify the relative strength of each predictor through meta-analytical techniques and develop machine learning-based risk prediction tools to enhance clinical decision-making. Additionally, longitudinal studies are warranted to examine ulcer recurrence and healing outcomes. The integration of behavioral health education and standardized screening protocols into routine diabetes care should also be prioritized to address the modifiable predictors of DFU.

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DATA AVAILABILITY

No datasets were generated or analyzed during the current study.

AUTHOR CONTRIBUTION

Yusron Amin was responsible for the conceptualization and design of the study, data collection, and the drafting of the initial manuscript. Haswita Haswita contributed to the methodology development, validation of data, critical analysis of findings, and revision of the manuscript. Both authors have read and approved the final version of the manuscript for submission and agree to be accountable for all aspects of the work.

DECLARATIONS

ETHICAL APPROVAL

As this study involved a review of previously published literature and did not involve human participants or animal subjects, ethical approval was not required.

CONSENT FOR PUBLICATION PARTICIPANTS.

Consent for publication was given by all participants

COMPETING INTERESTS

The authors declare no competing interests.

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