Screening Diabetic Foot Ulcer using Artificial Intelligence Modelling based on Digital Image Analysis: A Systematic Review

Avief Destian Purnama[1], Yuyun Yueniwati[2], Dina Dewi SLI[1], Heri Kristianto[1,*], Paulus Lucky Tirma Irawan[3], Rulli Rosadi[4], Rinik Eko Kapti[1], Ni Kadek Indah Sunar A[1]

[1]*Nursing Department, Faculty of Health Science, Brawijaya University, Malang, Indonesia*
[2]*Radiology Department, Faculty of Medicine, Brawijaya University, Malang, Indonesia*
[3]*Informatics Engineering Department, Faculty of Technology and Design, Ma Chung University, Malang, Indonesia*
[4]*Internal Medicine Department, Faculty of Medicine, Brawijaya University, Malang, Indonesia*
**corresponding author*: heri.kristianto@ub.ac.id

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Abstract

Aims: This study conducted a systematic review with the aim of identifying the predictive models used in the development of AI-based digital image analysis in Diabetic Foot Ulcer cases and determining the features and segmentation used in the construction of Diabetic Foot Ulcer screening algorithm models.

Methods: A systematic review was conducted by searching articles from ScienceDirect, PubMed, ProQuest, and CINAHL databases using a combination of relevant keywords. The selection process followed the PRISMA guidelines and article quality was assessed using the Mixed Methods Appraisal Tool (MMAT).

Results: A search of the electronic databases produced 374 research articles within the time range of 2019–2024, with an average article quality of 93% (strong). The results of this systematic review show that out of the eight articles, all were involved in developing an AI model, with seven articles developing convolutional neural network models and one article developing an artificial neural network model. Digital image analysis involved colour segmentation of tissues and areas of Diabetic Foot Ulcer, which can be used for screening.

Conclusion: The convolutional neural network AI model was used in two-dimensional digital imaging modalities for patients with diabetic foot ulcers. The development of an accurate prediction model can provide an automated system for assessing and monitoring Diabetic Foot Ulcer.
Keywords: artificial intelligence, diabetic foot ulcer, machine learning, screening

Introduction

Diabetes Mellitus (DM) is a metabolic disorder characterized by high blood glucose levels (hyperglycemia) (Das et al., 2023; Hao et al., 2023). The International Diabetes Federation (IDF) atlas reports that the prevalence of diabetes among those aged 20–79 in 2021 is estimated to be 10.5% (536.6 million people) and is projected to increase to 12.2% (783.2 million) by 2045 (Ahmad et al., 2024; Sun et al., 2023). Diabetic foot ulcers (DFU) are a common chronic complication and the leading cause of amputation in patients with diabetes (Celiker et al., 2021; Gosak et al., 2023). DFUs have a significant impact on an individual's quality of life and impose a substantial burden on the public healthcare system (Barnard-Kelly & Cherñavvsky, 2020; Demidowich et al., 2022; Nakajima, 2022). One way to prevent complications of DFU is through proper wound care (Coffey et al., 2019; Formosa et al., 2024). Effective DFU management requires a multidisciplinary team (doctors, nurses, and other healthcare professionals) who plays a crucial role in early detection, education, and effective treatment, including referrals to specialized DFU clinics (Barnard-Kelly & Cherñavvsky, 2020; Li et al., 2020; Thompson et al., 2024).

Despite the implementation of a multidisciplinary approach to DFU care, several critical challenges persist in the current screening process. One major issue is the delayed detection of wounds, particularly in primary care settings or among patients with neuropathy who may not notice symptoms. Moreover, evaluating wounds is still largely subjective and prone to inconsistency, as it depends on visual observations that may differ from one clinician to another. The availability of wound care specialists is lacking, particularly in remote areas or regions with limited healthcare facilities. Furthermore, documentation and regular monitoring of wound progression are often not conducted in a standardized and consistent manner, which makes it difficult to perform a comprehensive assessment. These challenges highlight the need for objective, scalable, and automated tools to support effective DFU management. This is where Artificial Intelligence (AI) holds significant potential.

AI is a manifestation of human-made machines as a branch of computer science and is used to analyze complex medical data (Grzeska et al., 2021; Mousa et al., 2023). AI applications are also used in the alignment of DFU images as an initial step in the wound care process (Cassidy et al., 2023; Chan & Lo, 2020). Convolutional neural networks (CNNs) are relevant models used in medical imaging. This convolutional architecture can scan image pixels, detect simple features, and combine these features into more complex forms (Ahmad et al., 2024). Furthermore, the combination of these filters can produce wound classification. The use of wound classification using AI can provide better results and cost-effectiveness than conventional methods (Basiri et al., 2024).

Previous research has shown that AI can be used to diagnose and predict DM and its complications. This has transformed the field with the introduction of AI-based solutions because of the ease of collecting massive amounts of data and the power of computational processing (Ahmad et al., 2024; Nanda et al., 2022). The use of AI in cases of DFU is expected to improve early diagnosis, data augmentation, data analysis, risk prediction, and the development of personalized wound care (Ahmad et al., 2024; Gosak et al., 2023). Additionally, by using this method, clinicians can better utilize predictive models to determine which high-risk diabetes patients should be monitored more closely and treated more intensively (American Diabetes Association Professional Practice Committee, 2022; Gosak et al., 2023).

In this systematic review, the authors summarized the research conducted and drew several conclusions regarding the potential directions for future research. Specifically, this study aims to: (I) identify the predictive models used in the development of AI-based digital image analysis in DFU cases and (II) determine the features and segmentation used in the construction of DFU screening algorithm models.

Methods

Search Strategy

The authors ADP and HK defined the search terms based on the research question. A systematic review was conducted by searching for articles that discussed the screening of diabetic foot ulcers using artificial intelligence. The literature search was guided by predetermined criteria aligned with the research objectives. The databases used for the search were ScienceDirect, PubMed, ProQuest, and CINAHL. Relevant search terms were identified by using Boolean operators to ensure a comprehensive and focused search. The detailed search strategy used in this review is summarized in Table 1.

Table 1. Search Strategy

Step	Search Terms / Actions
1	Artificial Intelligence; AI
2	Diabetic Foot Ulcer Prediction
3	Diabetic Foot Ulcer
4	Screening; Early Detection
5	Machine Learning; Deep Learning
6	Clinical Decision Support; Diagnostic Tool
7	Risk Assessment; Risk Prediction
8	Health Informatics; Medical Imaging
9	Combination: 1 AND (2 OR 3) AND 4 AND 5 AND 6 AND 7 AND 8

The inclusion criteria for the selected articles were as follows: (i) articles published between 2019 and 2024, (ii) articles written in Indonesian or English, (iii) randomized controlled trials, comparisons, correlations, original articles, and development of AI algorithm models; and (iv) the article should explain the construction of an AI model using digital image analysis of DFU. The results of the literature search were then systematically analyzed to obtain empirical evidence related to DFU screening using image-based AI. The exclusion criteria for this literature review were: (i) articles that were duplicates and review articles (such as systematic review, commentaries, narrative analysis, protocols, editorials, etc), (ii) sourced from encyclopedias, videos or books, (iii) not open access as full text (iv) does not explain the development of AI algorithms and does not use digital image analysis

Data Extraction
The results of the literature search of the four databases were filtered using the attached PRISMA flow (Figure 1). Subsequently, the author extracted data from each article by considering the year of the study, type of DFU assessed, prediction model system, DFU segmentation used, and measurement statistics. The quality of the articles was assessed based on the guidelines for assessing article quality using the Mixed Methods Appraisal Tool. The MMAT was conducted to assess and evaluate the quality of the selected primary documents and eliminate the possibility of bias. Data extraction and analysis were performed by the authors based on the main ethical aspects discussed in the scientific articles analyzed (Nha et al., 2018; Usman et al., 2023). This research protocol has also been registered inplasy (registration number is INPLASY202520018 and DOI number is 10.37766/inplasy2025.2.0018)

Results
A search of the electronic databases produced 374 research articles. After reviewing and removing duplicates, 365 full-text articles were obtained. Further analysis resulted in eight articles that met the research objectives. The analysis showed that all articles involved the development of AI prediction models for digital image-based DFU screening. One study developed a smartphone application to screen for DFU wounds. One study was a cohort study involving numerous DFU patients from 2009 to 2020 (Xie et al., 2022). Of the eight articles analyzed, seven used the convolutional neural network (CNN) method (Basiri et al., 2024; Biswas et al., 2023, 2024; Cassidy et al., 2023; Chairat et al., 2023; Nanda et al., 2022; Xie et al., 2022), and one study used an artificial neural network (Mousa et al., 2023). According to the article quality, the average article quality was 93% (strong). This shows that these articles are considered worthy of use as a basis for decision making or for further research. After assessing the quality of the scientific articles, the authors conducted an analysis of the models and approaches used in DFU screening (Biswas et al., 2023; Biswas et al., 2024; Gosak et al., 2023) (Table 2).

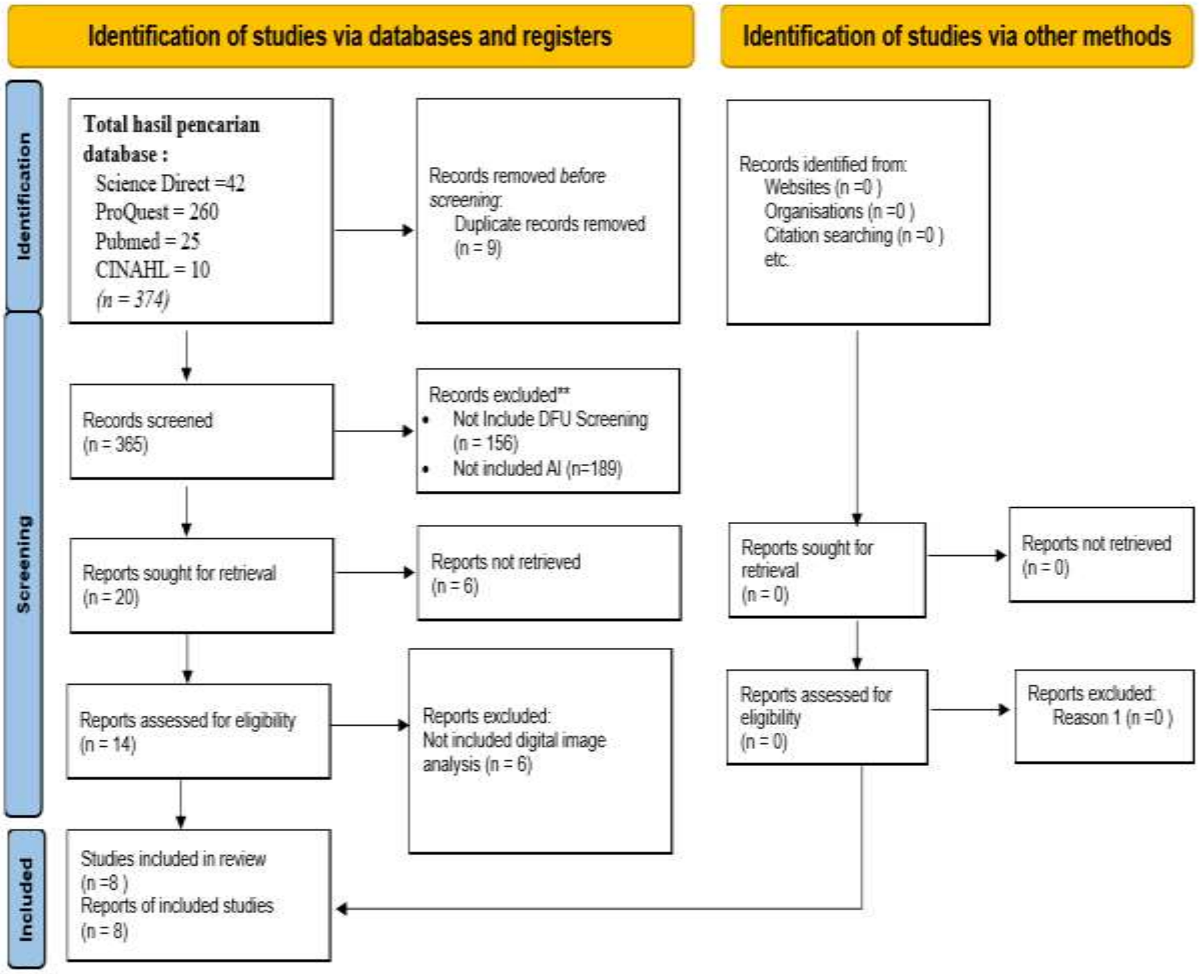

Figure 1. The flow of selecting scientific articles based on PRISMA (Preferred Reporting Items for Systematic Review

* The results of the literature search of the four databases were filtered following the attached PRISMA flow. Subsequently, the author extracted data from each article by considering the year of the study, type of DFU assessed, prediction model system, DFU segmentation used, and measurement statistics.

Table 2. Evaluation Results of the Critical Journal Assessment Checklist based on Mixed Method Appraisal Tool (MMAT)

Writer	Type of Study	Screening Questions		Quantitative Descriptive					Result
		1	2	3	4	5	6	7	
(Cassidy et al., 2023)	RCT + the development of an AI model	1	1	1	1	1	1	1	100%
(Biswas et al., 2023)	The development of an AI model	1	1	1	1	1	1	1	100%
(Biswas et al., 2024)	The development of an AI model	1	1	1	1	1	1	1	100%
(Xie et al., 2022)	Retrospective cohort and the development of an AI model	1	1	1	1	1	1	1	100%
(Basiri et al., 2024)	The development of an AI model	1	0	1	1	1	1	1	86%
(Mousa et al., 2023)	Case Control Study and the development of an AI model	1	0	1	1	1	1	0	86%
(Chairat et al., 2023)	The development of an AI prediction model	1	0	1	1	1	1	0	86%
(Nanda et al., 2022)	The development of an AI model	1	0	1	1	1	1	0	86%
Result									93% (STRONG)

* Average article quality is 93% (strong). This shows that these articles are considered worthy of use as a basis for decision making or for further research.

Table 2. Scientific Analysis Result

No	Author and year	Purpose of study	Method	People (Sample)	Outcome	Conclusion
1	Artificial intelligence for automated detection of diabetic foot ulcers: A real-world proof-of-concept clinical evaluation (Cassidy et al., 2023)	To evaluate and assess AI systems implemented on smartphones for the detection of diabetic foot ulcers (DFUs), with a focus on identifying the predictive models employed in AI-based digital image analysis,	AI model development using Faster R-CNN and Inception-ResNet V2 architecture models	DFU patients: 81 people and the number of foot photos collected: 203 photos	Predictions show sensitivity (0.9157), specificity (0.8857) and average identification time of 5.9 seconds.	The AI algorithm in this study is able to automatically detect diabetic foot ulcer segmentation using smartphone, cloud, and AI technology.
2	DFU_MultiNet: A deep neural network approach for detecting diabetic foot ulcers through multi-scale feature fusion using the DFU dataset(Biswas et al., 2023)	Introducing Diabetic Foot Ulcer Multinet, which focuses on using AI to classify images of healthy skin and those with ulcers.	AI model development using 3 deep learning CNN models: DenseNet201, VGG 19, and NasNetMobile	512 diabetic foot ulcer photos 543 healthy feet	The DFU_Multinet is based on heterogeneous parallel DL technology through three trained CNN models: DenseNet201, VGG 19, and NasNetMobile The "DFU_MultiNet" framework shows strong performance with an accuracy of 0.991 and specificity of 1.00.	DFU_Multinet can use wound area segmentation for the detection and screening of diabetic foot ulcers.
3	XAI-FusionNet: Diabetic foot ulcer detection based on multi-scale feature fusion with explainable artificial intelligence (Biswas et al., 2024)	Introducing XAI-FusionNet, which focuses on using AI to classify images of healthy skin and those with ulcers.	AI model development using 3 deep learning CNN models: DenseNet201, VGG 19, and NasNetMobile	3574 healthy foot photos 3389 diabetic foot ulcer photos	The XAI-Fusion Net achieves high accuracy (99.05%). XAI-FusionNet uses a CNN model with the addition of 3 algorithms, Grad-Cam, SHAP, and LIME, to determine the segmentation of wound growth rate, volume, tissue density, and diabetic foot ulcer area.	FusionNet is a high-performing DL model that combines multi-scale feature fusion with pre-trained CNNs to accurately detect diabetic foot ulcers (DFUs) from skin images. Achieving excellent classification performance, FusionNet outperforms existing models while maintaining strong interpretability through

						integrated explainable AI techniques such as SHAP, LIME, and Grad-CAM. Its effectiveness and transparency make it a reliable and clinically applicable tool for early DFU diagnosis, with the potential to support timely intervention and reduce diabetes-related complications.
4	An explainable machine learning model for predicting in-hospital amputation rate of patients with diabetic foot ulcer(Xie et al., 2022)	Developing an accurate and usable predictive model to estimate the risk of amputation in hospital patients with diabetic foot ulcers	Cohort Study and Development of a Predictive Model using Light Gradient Boosting Machine (LightGBM) model and 5-fold cross-validation tool and SHAP algorithm	618 patients with diabetic foot ulcers treated at the hospital	The developed model showed an accuracy of 0.90, sensitivity of 87.1% and specificity of 74.4%	This predictive model uses segmentation of the presence of diabetic foot ulcers and the addition of the SHAP algorithm can provide a visual interpretation of the contribution of patient characteristics to model predictions and is used to directly obtain data that can be predicted for amputation events.
5	Protocol for metadata and image collection at diabetic foot ulcer clinics: enabling research in wound analytics and deep learning (Basiri et al., 2024)	Establishing a standard framework for collecting diabetic foot ulcer data using artificial intelligence	Development of a Protocol Model using DL and ML CNN and using the Zivot dataset with bounding box annotations and the EfficientNet-Unet model	269 patients with diabetic foot ulcers	The DL application showed an accuracy of 0.98.	This model is able to predict the development of diabetic foot ulcers using colour segmentation on diabetic foot ulcers
6	Prediction of Foot Ulcers Using Artificial Intelligence for Diabetic Patients at Cairo University Hospital, Egypt (Mousa et al.,	Designing an artificial intelligence-based neural network and decision tree algorithm for predicting diabetic foot ulcers	Case Control Study and development of an ANN model using MATLAB and image interpretation with	200 patients with diabetic foot ulcers	ANN produced an accuracy rate of 0.97, sensitivity of 0.95 and specificity of 1.00.	This model is able to predict diabetic foot ulcers using diabetic foot ulcer segmentation and the creation of a decision tree related to

	2023)		Fourier Transform (FT)			the classification of diabetic foot ulcer tissue.
7	AI-Assisted Assessment of Wound Tissue with Automatic Colour and Measurement Calibration on Images Taken with a Smartphone (Chairat et al., 2023)	Developing an automated wound assessment system that combines colour calibration, automatic measurement, and AI algorithms.	Development of a CNN Prediction Model using U-Net with Efficient Net and U-Net with MobileNetV2	31 wound images from 20 patients with diabetic foot ulcers	The algorithm achieved an accuracy of 0.98 and is capable of segmenting wound areas, epithelialization areas, granulation tissue, and necrotic tissue.	The calibration chart can help calibrate colour and scale, improving algorithm performance.
8	Machine learning algorithm to evaluate risk factors of diabetic foot ulcers and its severity (Nanda et al., 2022)	Understanding the relationship between various clinical and biochemical risk factors and diabetic foot ulcers and developing a prediction model using different machine learning algorithms.	Development of a machine learning prediction model by developing Support Vector Machine (SVM-Poly K), Naive Bayes (NB), K-nearest neighbor (KNN), random forest (RF) and three ensemble learners: Stacking C, Bagging, and AdaBoost	80 diabetic foot ulcer images	The use of this algorithm provides an accuracy rate of 93.8, sensitivity of 93.8, and specificity of 93.8.	The algorithm model uses wound area segmentation and adds risk factors for the occurrence of diabetic foot ulcer area.

* The analysis showed that all articles involved the development of AI prediction models for digital image-based DFU screening. One study developed a smartphone application to screen for DFU wounds. One article was a cohort study involving numerous patients with DFU between 2009 and 2020. Of the eight analyzed articles, seven used the convolutional neural network (CNN) method and one used an artificial neural network.

Discussion

Diabetic Foot Ulcer Screening Prediction Model

AI is a comprehensive technological system that mimics human intelligence. AI uses a learning system known as machine learning (ML). ML is a subset of AI that focuses on developing algorithms and statistical models that enable computers to learn and make predictions. Deep learning (DL) is a subfield of AI that focuses on developing algorithms that can process complex data using deep and complex neural network structures (Chairat et al., 2023; Mousa et al., 2023). DL uses neural networks to form learning architectures that can model decision-making processes similar to those of the human brain (Hodgson & Tyler, 2024; Priyadarsini et al., 2023).

Neural networks are categorized into three types: artificial neural networks (ANN), convolutional neural networks (CNN), and recurrent neural networks (RNN) (Hodgson & Tyler, 2024). An ANN is a feedforward neural network in which the input is processed in a single direction, allowing simpler and more interpretable computations (Mousa et al., 2023). A CNN is a neural network computation method that employs variations in interconnected multilayer perceptrons. CNN can capture images and offer high accuracy in image recognition (Basiri et al., 2024; Biswas et al., 2023; Biswas et al., 2024; Cassidy et al., 2023; Chairat et al., 2023; Nanda et al., 2022; Xie et al., 2022). An RNN is a more complex computational model that incorporates memory units to facilitate learning over sequences, such as time-series data (Rasul et al., 2020; Ren et al., 2022).

The CNN prediction models in the reviewed articles showed excellent performance (Basiri et al., 2024; Biswas et al., 2023, 2024; Cassidy et al., 2023; Chairat et al., 2023; Nanda et al., 2022; Xie et al., 2022). The CNN prediction model found in this study achieved an accuracy of up to 99% and could perform identification with an average time of 5.9 seconds (Cassidy et al., 2023). This prediction model uses algorithms including Grad-Cam, SHAP, and LIME. The Grad-Cam algorithm enriches interpretability by providing a detailed localization of important areas in the sample, allowing users to distinguish which input aspects substantially influence the classifier's prediction to a certain degree. The SHAP algorithm was used to explain confusion, locality, and consistency, supporting its popularity as a strong choice for model explanation. The LIME algorithm has been used to observe the key features that differentiate between ulcerated and normal skin samples (Biswas et al., 2023; Biswas et al., 2024; Nanda et al., 2022; Xie et al., 2022). The addition of the Stacking C algorithm from the two best-performing algorithms improves the prediction accuracy for both classification stages (Nanda et al., 2022). The ANN prediction model achieved an accuracy of 97% by successfully segmenting the wound, epithelialization, granulation, and necrotic tissues (Mousa et al., 2023). Calibration charts were also applied to improve colour and scale consistency, enhancing algorithm performance (Chairat et al., 2023; Chemello et al., 2022)

The Xai-Fusion Net was improved through a heterogeneous parallel ensemble that learned features through three trained models: DenseNet201, VGG19, and NasNetMobile (Biswas et al., 2023; Biswas et al., 2024). The use of this framework can improve the efficiency and effectiveness of clinical research and health care systems. One example of a clinically tested model is DFU-MultiNet, which classifies diabetic foot skin using a hybrid framework (Gosak et al., 2023; Piran et al., 2024; Wang et al., 2022). This model uses three different models; therefore, if one model fails to extract features, another model will extract those features, thus improving the ability to adapt to changes in imbalanced datasets (Demidowich et al., 2022; Molla et al., 2023; Yang et al., 2023).

The analysis revealed that the reviewed studies employed AI to develop diabetic foot ulcer (DFU) screening systems based on digital image analysis. Various approaches have been applied, including wound tissue modeling through color and texture segmentation, as well as tissue classification, to assess the severity and healing stage of ulcers. These AI models have demonstrated improved accuracy in early diagnosis and enhanced efficiency in ongoing wound monitoring. These approaches are further supported by the use of DL algorithms and mobile technology integration, enabling accessible and autonomous screening. These findings underscore the significant potential of AI in enhancing the early detection and clinical management of diabetic foot ulcers across diverse healthcare settings.

The Features And Segmentation Used In The Construction Of DFU Screening

The application of AI in medical diagnostics has demonstrated significant potential for enhancing the accuracy and efficiency of DFU detection across various stages and tissue types. Several studies have investigated the use of AI, which encompasses ML and DL, for screening and predicting DFUs. Khandakar et al. (2021) focused on thermal imaging (thermograms) to identify the abnormal temperature distributions associated with early tissue damage. Their findings highlighted the capability of AI to analyze subtle thermal patterns and detect ulceration risks prior to visible manifestation (Khandakar et al., 2021). Cassidy et al. (2023) developed a predictive AI model utilizing clinical and imaging data to identify patients at a high risk of developing DFUs, thus supporting proactive and individualized care strategies (Cassidy et al., 2023). Furthermore, Roberto (2020) demonstrated that AI algorithms can automatically detect DFUs with varying levels of accuracy, sensitivity, and specificity, depending on the tissue type analyzed. These algorithms also facilitate the classification of ulcerated versus healthy tissues, offering enhanced reliability in the diagnostic and monitoring processes (Roberto, 2020).

The algorithm can accurately detect DFUs in various parts of the foot at various developmental stages. Accurate screening is a crucial step in the automated monitoring of diabetic foot ulcers (Biswas et al., 2023; Nanda et al., 2022; Wang et al., 2022). The automatic AI detection of DFUs in the study by Cassidy et al. showed that screening and monitoring were performed automatically using a smartphone. A smartphone application can provide information on the location, size, and number of DFUs (Cassidy et al., 2023). DFU detection using AI must allow for partially visible wound areas on the curvature of the foot (shown on the back of the foot) and diabetic foot ulcers surrounded by tissue with a large debridement area (shown on the anterior) (Biswas et al., 2023; Biswas et al., 2024; Chairat et al., 2023; Xie et al., 2022). The AI algorithm is also able to detect partially visible toenails adjacent to the wound, indicating a non-well-defined boundary between the nail and the wound

(Basiri et al., 2024; Biswas et al., 2024). DFU screening can also be performed by observing the segmentation of the basic wound color and the type of tissue that appears. The color of the wound bed provides essential clinical insights into tissue viability and healing process. The red wound bed indicates granulation tissue and active healing. A yellow wound bed suggests the presence of slough or nonviable tissue, which may require debridement. A black wound bed signifies necrotic tissue (eschar), which is non-viable and may pose a risk of infection, warranting further clinical evaluation (Basiri et al., 2024; Chairat et al., 2023).

Prediction Model Interpretation

AI prediction models can be interpreted using performance measurement parameters: F1 score, recall, precision, and accuracy of the confusion matrix (Chan & Lo, 2020). These parameters are derived from four values: false positive (FP), false negative (FN), true positive (TP) and true negative (TN). The correct label indicates a correct identification, whereas an incorrect label indicates an incorrect identification (Akhtar, 2024; Salati, 2021). Currently, AI-based digital image analysis can be used to (1) identify the diabetic foot ulcer healing process and (II) predict cases of non-amputation, minor amputation, and major amputation in diabetic foot ulcer patients by developing a multi-classification model (Xie et al., 2022). Digital image analysis can provide AI model interpretation with color segmentation and tissue type (Basiri et al., 2024; Chairat et al., 2023). The images analyzed in the study were usually taken with a smartphone or tablet, and did not require high-tech imaging. The use of artificial imaging features and raw clinical attributes in prediction algorithms provides better insight for clinicians and patients (Chan, 2021; Chan & Lo, 2020; Tulloch et al., 2020).

This AI model contributes to early detection in medical images, facilitating rapid intervention and ultimately improving patient outcomes. This AI model excels in analyzing large amounts of medical images in a short span of time, allowing doctors to make faster and more accurate decisions (Parizad et al., 2021; Piran et al., 2024; Wang et al., 2022). Smartphone applications are also widely used in the detection and monitoring of diabetic foot ulcers. One example is the development of the "My Foot Care application," which is used for self-care and semi-automatic procedures. The application employs follow-up analysis techniques for basic image processing from the initial foot photos (Biswas et al., 2024; Cassidy et al., 2023; Xie et al., 2022).

Limitations

The main limitation of this study is its heterogeneity because the authors included different types of research with different prediction models. Classification models can achieve more accurate predictions by using balanced datasets and significant sample numbers. Expanding the datasets also means more detailed clinical information, including the most common variables included in the prognostic model (Chan, 2021; Chan & Lo, 2020; Shah et al., 2022). Although the available data and studies are still relatively limited, this review remains meaningful as an initial step toward understanding the advancement of AI technology for early DFU screening. With more samples and research, it is hoped that the accuracy of the prediction model can be improved and can be performed in daily practice for the early screening of diabetic foot ulcers. This allows for faster treatment and avoids costly costs and other consequences for patients. We hope that this AI technology will be used extensively in clinical settings and will greatly improve the treatment of patients with diabetic foot ulcers.

Contribution to Global Nursing Practice

The integration of AI-assisted wound analysis into nursing practice can significantly enhance clinical efficiency and diagnostic accuracy, particularly in the detection and management of diabetic foot ulcers (DFU), especially in resource-limited and remote regions. AI technology enables rapid and accurate wound assessment through two-dimensional image analysis, thereby supporting the early detection of DFU, accelerating clinical decision-making, and preventing serious complications such as infections or amputations. This approach also encourages the implementation of standardized wound management practices, strengthens the role of nurses in the continuous monitoring of patient conditions, and contributes to the improvement of nursing service quality and healthcare cost efficiency on a global scale.

Conclusions

This systematic review demonstrates that AI-based systems, particularly convolutional neural network (CNN) models with two-dimensional (2D) image inputs, exhibit high effectiveness in the segmentation and analysis of diabetic foot ulcers (DFU). The implemented CNN models utilized an encoder-decoder architecture with convolutional blocks arranged hierarchically by depth, enabling detailed and accurate feature extraction from wound images. The evaluation results from various reviewed studies show consistently high accuracy and specificity in identifying and classifying wound tissues. These findings reinforce the clinical feasibility of applying such AI systems as assistive tools in wound assessment, potentially supporting healthcare professionals in providing precise diagnoses, and standardized and reproducible DFU care management.

Author contribution

Conceptualization: ADP and HK.; methodology: ADP, YY, DDS, HKS, and REK. and G.S.; formal analysis: ADP, YY, DDS, HKS, and REK.; writing—original draft preparation: ADP.; writing—review and editing: ADP and NIS.; supervision: ADP, YY, DDS, HKS, and REK. All the authors have read and agreed to the published version of the manuscript.

Conflict of interest
The Authors declare no conflicts of interest.

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