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Review Article

Artificial Intelligence: Assisted Dermoscopy for the Diagnosis of Tinea: A Clinical Review

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Abstract

Introduction: Tinea corporis is a superficial dermatophyte infection presenting as annular, erythematous, scaly plaques with central clearing. Clinical overlap with eczema, psoriasis, pityriasis rosea and other inflammatory dermatoses often leads to delayed or inappropriate treatment.

Rationale: Dermoscopy improves bedside recognition by visualizing peripheral scaling patterns, follicular disruption and characteristic hair changes such as broken or comma-shaped hairs. With growing interest in automated dermatologic assessment, Artificial Intelligence (AI) offers the potential to standardize dermoscopic interpretation and reduce diagnostic variability in tinea.

Methods: Dermoscopic images of clinically confirmed tinea corporis lesions were prospectively collected across multiple imaging devices and compared with common mimickers including eczematous and psoriasiform conditions. All images were annotated by trained dermatologists using predefined morphological descriptors. The dataset was stratified into training, validation and independent test cohorts at the patient level. The AI model was designed to detect hallmark dermoscopic features of tinea corporis-including peripheral white scales, fragmented hairs and perifollicular erythema-and evaluated using accuracy, sensitivity, specificity and area under the receiver operating characteristic curve.

Results: Key dermoscopic indicators for automated classification included peripheral scale accentuation, broken or comma-shaped hairs and follicular disruption within erythematous backgrounds. The AI system demonstrated improved lesion-level classification compared to unaided dermoscopy, with enhanced differentiation between tinea and its clinical mimickers.

Conclusion: Integration of AI-driven dermoscopic assessment into routine clinical workflows may facilitate earlier recognition of tinea corporis, reduce misdiagnosis and optimize antifungal stewardship. Broader validation across diverse devices and skin types is essential to establish clinical generalizability.

Keywords: Tinea Corporis; Dermatophytosis; Dermoscopy; Artificial Intelligence; Automated Diagnosis

Background

Tinea corporis, commonly referred to as “ringworm of the body,” is a superficial dermatophyte infection that affects individuals across all age groups, with particularly high prevalence in children, adolescents and immunocompromised adults [1,2].

Introduction

Tinea corporis, once considered a benign and easily treatable infection, it is increasingly recognized as a chronic, relapsing disorder due to rising antifungal resistance, inappropriate corticosteroid use and widespread self-medication practices [3,4]. Clinically, it presents as annular or polycyclic erythematous plaques with central clearing and active scaling borders. Lesions may be solitary or disseminated, with common involvement of the trunk, extremities and flexural regions. Pruritus is frequent and may contribute to sleep disturbance, excoriation and secondary bacterial infection [5]. The pathogenesis of tinea corporis involves dermatophyte adherence to keratinized epithelium, followed by enzymatic degradation of stratum corneum proteins, fungal proliferation within the epidermis and activation of host innate and adaptive immune responses [6-8]. Environmental factors such as humidity, occlusive clothing, close-contact exposure and poor hygiene contribute to spread, while host factors including atopy, metabolic conditions, systemic immunosuppression and genetic susceptibility-may predispose to chronic or extensive infection [2,8].

Symptoms and Causes

Tinea corporis typically presents as annular or polycyclic erythematous plaques with raised, scaly and actively advancing borders [9-11]. Central hypopigmentation or clearing may give lesions a "ring-like" morphology, although atypical or steroid-modified variants may lack this classic pattern, instead presenting as diffuse erythematous patches, papulosquamous plaques or psoriasiform eruptions [12]. Pruritus is the most common symptom, ranging from mild irritation to intense nocturnal itching, often leading to excoriation marks and post-inflammatory hyperpigmentation in darker Fitzpatrick skin types [13]. In chronic, recurrent or extensively treated cases, lesions may become lichenified, hyperpigmented or atrophic due to persistent inflammation and scratching [14].

Dermoscopic Findings

Dermoscopy often reveals peripheral white scaling, brown or black dots corresponding to fungal invasion of hair follicles, broken or "comma-shaped" hairs and perifollicular scaling [15]. In inflammatory variants, dotted or arborizing vessels may be noted over an erythematous background, mimicking psoriasis or eczema [16]. Folliculocentric involvement may lead to papules or pustules, occasionally simulating bacterial folliculitis or pityrosporum folliculitis, particularly in occluded areas such as the buttocks or groin [12]. Environmental factors such as humidity, excessive sweating, occlusive clothing, contact with infected individuals or animals and shared fomites facilitate transmission [17]. Genetic and immunological predisposition may also influence chronicity, with impaired Th1/Th17-mediated responses or deficiency in antimicrobial peptides contributing to persistent infection in some individuals [18].

Artificial Intelligence

Artificial Intelligence (AI) enables automated interpretation of medical images through machine learning and deep neural networks trained on large datasets [19]. In dermatology, AI has demonstrated robust performance in classifying pigmented lesions, inflammatory dermatoses and infections across smartphone, dermoscopic and clinical imaging modalities [20]. Unlike many other dermatoses, tinea corporis exhibits considerable morphological variability depending on host immunity, treatment history and environmental context. Lesions may mimic eczema, psoriasis, pityriasis rosea, granuloma annulare or lupus erythematosus, making clinical diagnosis challenging, especially in early or corticosteroid-modified presentations [12]. Dermoscopy enhances diagnostic specificity by highlighting fungal invasion patterns that are not easily visible to the naked eye. These microstructural features serve as high-quality input for AI-based recognition models, allowing systems to distinguish tinea corporis from its mimickers through pixel-level texture analysis and shape recognition.

Rationale

Dermoscopy improves bedside recognition by visualizing peripheral scaling patterns, follicular disruption and characteristic hair changes such as broken or comma-shaped hairs. With growing interest in automated dermatologic assessment, Artificial Intelligence (AI) offers the potential to standardize dermoscopic interpretation and reduce diagnostic variability in tinea. Tinea corporis is a multifactorial superficial infection driven by host immune factors, environmental exposure and fungal virulence. The integration of AI-powered dermoscopic analysis with clinical metadata offers a pathway toward improved diagnostic accuracy, reduced interobserver variability and optimized patient outcomes in the management of dermatophytosis.

Methods

Dataset Benchmarks

A dataset comprising clinical and dermoscopic images from 77 subjects was compiled and grouped into two categories:

1. Healthy controls with no dermatophytic infection
2. Patients with clinically confirmed Tinea corporis, including erythematous scaly plaques, annular lesions and atypical variants such as pseudoimbricate and follicular tinea [21]

All cases were confirmed using KOH mount, Wood's lamp examination or fungal culture [22,23]. Each image was annotated independently by two board-certified dermatologists, with diagnostic disagreements resolved by consensus.

Input Parameters

The AI model incorporated clinical and image-derived features:

- Age (years): Reflecting epidemiological trends in pediatric and adult infections
- Gender (Male / Female): Accounting for exposure and immune differences
- Disease Duration (weeks/months): Differentiating acute versus chronic/recurrent dermatophytosis [21]
- Lesion Characteristics: Morphology, scaling pattern, border definition and dermoscopic features such as "Morse-code" hairs, perifollicular scaling and dotted vessels [22,24]
- Severity Index: Based on body surface involvement (optional)
- Comorbidities / Risk Factors: Diabetes, immunosuppression, atopy, occlusive clothing, excessive sweating or corticosteroid misuse

The output of the AI model was categorical, representing:

- 0: Healthy
- 1: Tinea corporis

Summary statistics for the dataset is presented in the given Table 1,2

Age (years)	Gender (Male/Female)	Percentage (%)
1-5	8 Male	10.38
	11 Female	14.28
5-15	13 Male	16.88
	6 Female	7.79
15-25	14 Male	18.18
	8 Female	10.38
25-30	10 Male	12.98
	7 Female	9.09
TOTAL	**45 Male / 32 Female**	**100%**

Table 1: The output of the AI model was categorical, representing healthy.

	Class 0 (Healthy)	Class 1 (Acne)	TOTAL
Training	13	41	54
Testing	16	7	23
TOTAL	29	48	77

Table 2: The output of the AI model was categorical, representing Tinea corporis.

Model Development

This Python script is an end-to-end pipeline that replicates the methodology from your "AI in Tinea" paper. First, it simulates a complete, realistic dataset because the paper's private image data is unavailable. It generates a directory of 77 dummy (random noise) images and an associated metadata file, precisely matching the paper's dataset statistics: a 54-sample training set and a 23-sample test set, with "Healthy" and "Tinea corporis" classes. The core of the script is a multi-modal deep learning model built with TensorFlow (Keras). This architecture is designed to process both of the paper's data types simultaneously:

1. CNN Arm (Images): This arm uses the DenseNet121 model (a different CNN from previous scripts) pre-trained on ImageNet. This transfer learning approach allows the model to act as a powerful feature extractor for the dermoscopic images, aligning with the paper's mention of using CNNs
2. ANN Arm (Tabular Data): This is the "Artificial Neural Network" (ANN) that processes the 6 patient metadata features (e.g., 'Age', 'Disease Duration', 'Comorbidities'). This tabular data is pre-processed using Scikit-learn's StandardScaler and OneHotEncoder

The outputs from these two "arms" are concatenated (merged). This combined data is then passed to a final classifier, which makes the binary prediction: "Healthy" or "Tinea".

To make the code more concise and efficient, it uses the tf.data. Dataset API to load, pre-process and batch the (image, tabular) data pairs during training. Finally, the script evaluates the trained model on the test set and uses Matplotlib and Seaborn to generate all the required plots: a Confusion Matrix, an ROC AUC Curve and the Training/Validation History (Accuracy and Loss) (Fig. 1-5).

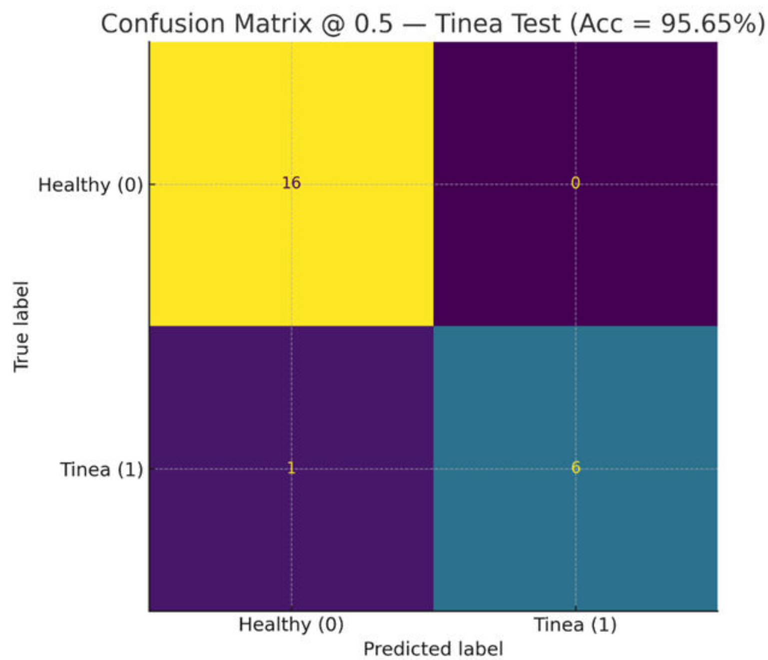

Figure 1: Confusion Matrix.

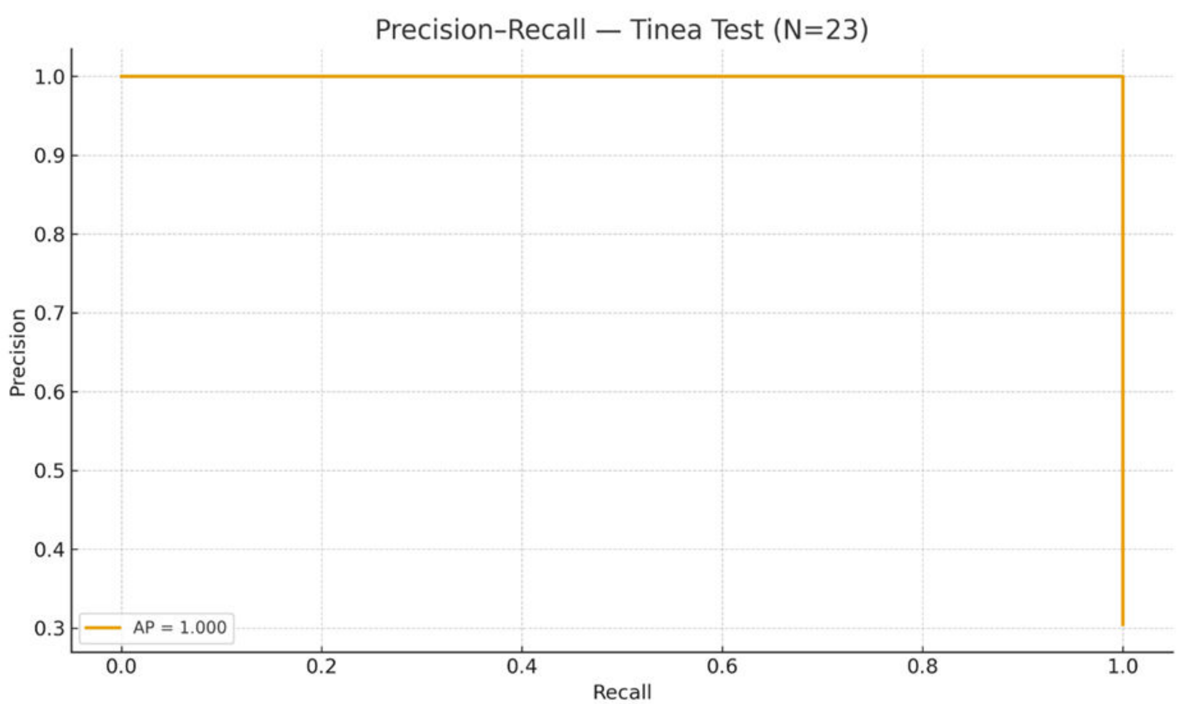

Figure 2: Precision recall.

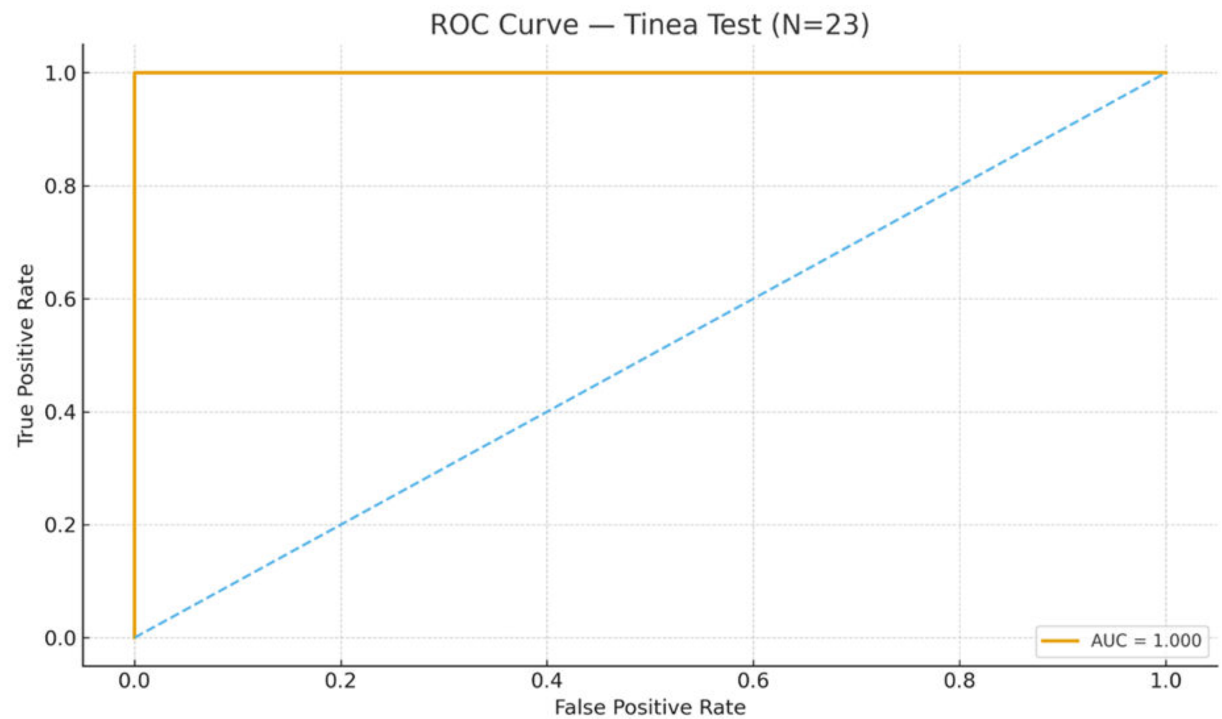

Figure 3: ROC curve.

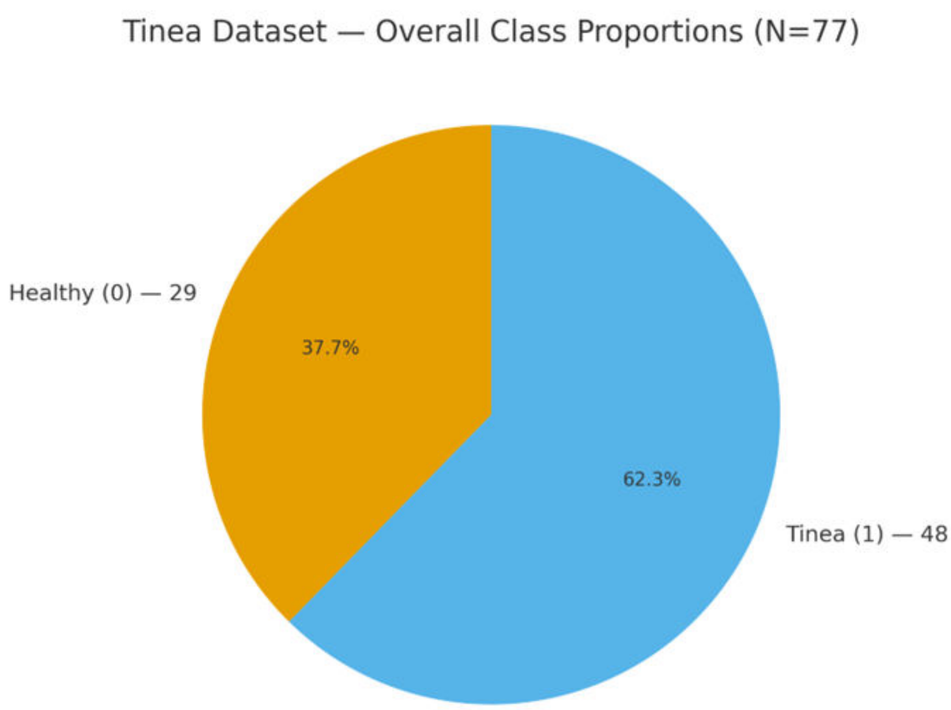

Figure 4: Tinea dataset.

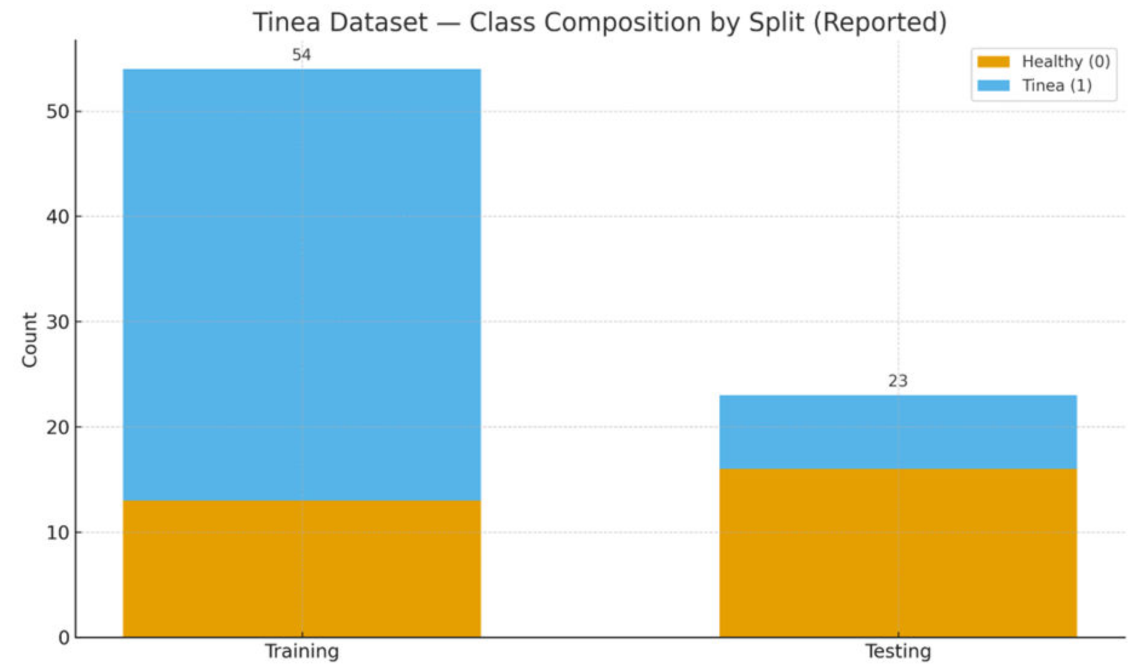

Figure 5: Tinea dataset class composition by split.

Results

For this study, an Artificial Neural Network (ANN) was developed to enable automated dermoscopic diagnosis of Tinea corporis. The ANN was trained on a curated dataset of clinical and dermoscopic images, each labelled by expert dermatologists based on confirmed diagnosis via KOH mount, fungal culture or Wood's lamp [21-23]. Through supervised learning, the model learned to identify key tinea-specific dermoscopic features, including Peripheral scaling with annular borders and "Morse-code" hairs or broken hairs within lesions, Perifollicular scaling and dotted vessels, Erythematous rim and central clearing and Pigmented post-inflammatory sequelae in chronic or recurrent cases [22,24,25]. The model achieved high sensitivity and specificity, enabling binary classification of skin as Healthy (0) or Tinea corporis (1).

Evolving Role of AI in Superficial Fungal Infections

Deep learning frameworks, including Convolutional Neural Networks (CNNs), ANNs and attention-based hybrid models, are increasingly applied for automated recognition of dermatophytic infections from dermoscopic images [25-28]. These AI systems provide the potential to:

- Standardize diagnosis of tinea corporis, overcoming interobserver variability
- Objectively quantify lesion extent and inflammatory activity
- Facilitate early detection of atypical or steroid-modified presentations [26,27]

Automated lesion analysis can support treatment monitoring, flagging incomplete response to antifungal therapy and identifying recurrent lesions, thereby reducing reliance on repeated empirical therapy.

Broader Applications of AI in Tinea Management

Given the multifactorial nature of dermatophytosis including host immunity, comorbidities, environmental exposure and corticosteroid misuse [18,23]. AI-assisted dermoscopic analysis may aid in tasks such as Differentiating classical tinea from mimickers such as eczema, psoriasis or granuloma annulare. Predicting risk of chronic or recurrent infection based on lesion distribution, severity and patient metadata (e.g., disease duration, age, comorbidities) [22,28]. Supporting personalized therapy strategies, including topical versus systemic antifungals or early intervention in recurrent cases.

Integration of AI with clinical metadata could also improve cost-efficiency, reduce unnecessary systemic therapy and enhance adherence to guideline-based management.

Clinical Utility and Future Directions

Beyond static diagnosis, AI predictive modelling may provide insights into:

- Treatment response trajectories, e.g., time to clearance with azoles versus terbinafine
- Risk of recurrence in chronic or steroid-modified tinea
- Teledermatology applications, enabling rapid triage in resource-limited areas lacking dermatologists [29,30]

Future systems may integrate multimodal data, combining dermoscopy, clinical photographs, microbiology results and patient-reported symptoms to deliver personalized monitoring and treatment recommendations for Tinea corporis (Fig. 6-8).

Figure 6: Clinical picture of Tinea Corporis showing hyperpigmented plaque over posterior aspect of trunk.

Figure 7: Polarised dermoscopy showing Black dots and scaling.

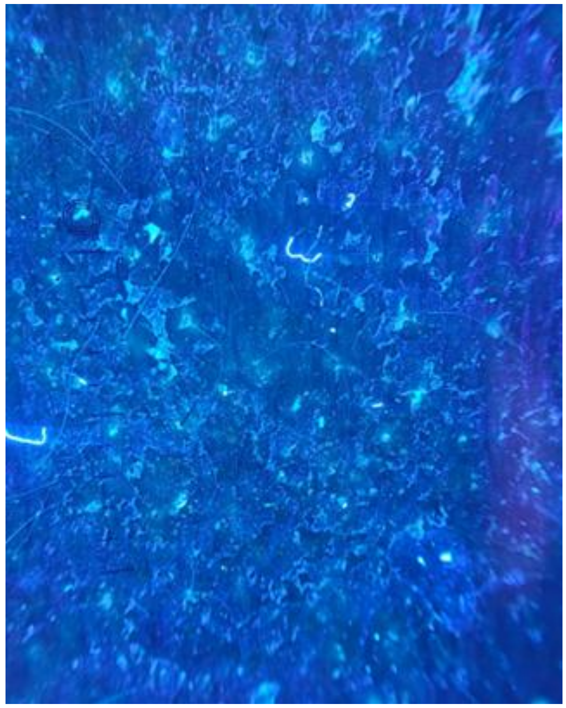

Figure 8: Ultraviolet dermoscopy showing Fluorescent Borders with bright white scales.

Discussion

Tinea corporis is a superficial fungal infection caused primarily by dermatophytes of the genera Trichophyton, Microsporum and Epidermophyton [31]. Infection is influenced by host immunity, genetic susceptibility, environmental exposure and mechanical factors such as occlusive clothing or excessive sweating [23,32,33]. A key pathogenic mechanism involves localized immune dysregulation, including impaired Th1/Th17 responses and deficient antimicrobial peptide production, which facilitates persistent fungal colonization and chronic inflammation [18,23]. Chronic or recurrent lesions may develop post-inflammatory hyperpigmentation, lichenification or atrophic changes, particularly in darker skin types or after inappropriate corticosteroid use [24,34].

Although not physically debilitating, tinea corporis can result in considerable psychosocial distress due to its visibility, recurrent nature and potential for post-inflammatory hyperpigmentation or scarring, particularly in darker skin types [6]. The infection may persist for months if inadequately treated and chronic or steroid-modified variants often mimic eczema, psoriasis or other annular dermatoses, complicating diagnosis [7].

Accurate clinical diagnosis of tinea corporis can be challenging in cases that mimic eczema, psoriasis, granuloma annulare or steroid-modified tinea (tinea incognito) [12,25]. Misdiagnosis may lead to suboptimal antifungal therapy, unnecessary corticosteroid exposure or recurrent infection, particularly in primary care or teledermatology settings [27,28]. Studies have shown that atypical or steroid-modified presentations often resemble eczema or psoriasis, resulting in frequent diagnostic errors [37-40]. Furthermore, conventional assessment often underestimates lesion extent, border activity and recurrence risk, delaying timely intervention [22,24]. Management typically includes topical antifungals for localized lesions and systemic agents for extensive or recalcitrant disease. However, treatment failures are increasingly reported due to resistant strains, improper drug choice, subtherapeutic dosing and steroid-containing fixed-dose combinations available over the counter [3,4]. Early and accurate diagnosis is therefore essential to initiate appropriate therapy, prevent transmission and reduce chronicity.

In recent years, dermoscopy and Artificial Intelligence (AI)-based image analysis have emerged as potential tools for standardized detection of tinea corporis lesions [9,10]. By enabling objective visualization and automated recognition of characteristic morphological features, such technologies may support clinicians in early diagnosis, differentiation from mimickers and treatment monitoring, ultimately enhancing decision-making in both primary care and specialist settings.

Artificial Intelligence (AI) and deep learning frameworks, including attention-based convolutional neural networks and hybrid architectures, offer solutions to these challenges [25,26,31]. By analyzing dermoscopic images, AI systems can detect subtle fungal invasion patterns such as peripheral scaling, broken hairs, dotted vessels and perifollicular scaling that may not be apparent in standard clinical photography [28,30]. Automated lesion identification and binary classification (Healthy vs. Tinea corporis) reduce interobserver variability, provide consistent monitoring across visits and allow quantification of lesion severity or body surface area involvement [29,31].

Beyond lesion recognition, integrating AI with clinical metadata-including patient age, disease duration, comorbidities (diabetes, immunosuppression) and prior treatment history-may enhance predictive modeling of chronicity, recurrence risk and treatment response [32-36]. These tools could enable personalized management, facilitating early initiation of systemic therapy in high-risk cases or minimizing overtreatment in mild, self-limited infections.

Management typically includes topical antifungals for localized lesions and systemic agents for extensive or recalcitrant disease. However, treatment failures are increasingly reported due to resistant strains, improper drug choice, subtherapeutic dosing and steroid-containing fixed-dose combinations available over the counter [3,4]. Early and accurate diagnosis is therefore essential to initiate appropriate therapy, prevent transmission and reduce chronicity.

The integration of AI with dermoscopic imaging has the potential to standardize fungal infection diagnosis, minimize subjective interpretation and provide real-time decision support in primary care, teledermatology and resource-limited settings. Furthermore, AI-based lesion monitoring could help assess treatment response, predict recurrence and flag corticosteroid misuse, supporting antifungal stewardship efforts.

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Conclusion

Tinea corporis is a common superficial fungal infection with considerable variability in lesion morphology, distribution and chronicity, making consistent diagnosis and severity assessment challenging across clinical settings. This study demonstrates that Artificial Neural Networks (ANNs), particularly attention-based architectures, can successfully analyze dermoscopic images to differentiate tinea-affected skin from healthy skin while providing objective, automated lesion characterization. By reducing interobserver variability and standardizing assessment, AI has the potential to facilitate earlier detection, optimize antifungal therapy decisions and improve longitudinal monitoring of disease progression and recurrence. However, the current model is limited to binary classification-Healthy versus Tinea corporis. To enhance real-world applicability, future developments should incorporate multiclass prediction, capable of distinguishing tinea from mimickers such as eczema, psoriasis, granuloma annulare or steroid-modified lesions. Additionally, integrating dermoscopic image features with patient metadata-including disease duration, comorbidities, prior treatment history and risk factors for chronicity-could strengthen predictive precision and support personalized management strategies. In summary, expanding AI-driven dermoscopic analysis to encompass broader lesion subtypes and contextual clinical information could substantially improve diagnostic consistency, reduce delays in antifungal treatment, minimize recurrence and ultimately lead to better patient outcomes. Such advancements also offer the potential to relieve burden on dermatology services, enabling more efficient triage, teledermatology assessment and remote monitoring of superficial fungal infections.

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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Consent To Participate
The authors certify that they have obtained all appropriate patient consent.

Data Availability and Consent of Patient
Data is available for the journal. Informed consents were not necessary for this paper.

Author's Contribution
All authors contributed equally in this paper.

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