Review Article

Cutaneous manifestations in HIV/AIDS infections: Insight into prevalence patterns, CD^{4+} correlations, and public health implications from a global perspective

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Abstract

Cutaneous manifestations in patients with HIV/AIDS are used as clinical markers to identify disease progression and immune status; however, there is currently no comprehensive review examining this evidence. This comprehensive review aims to synthesize the evidence and analyze the prevalence patterns of skin manifestations, their correlation with CD4+ T-cell levels, and their public health implications. A systematic literature review was conducted following the PRISMA guidelines by searching PubMed/MEDLINE, Scopus, Web of Science, Google Scholar, and GARUDA for literature from 2009 to 2024. Quantitative data on clinical manifestations were extracted from the original studies. A total of 4,700 studies were identified, of which 16 met the inclusion criteria of this review. Studies from Asia (*n*=9), Africa (*n*=5), South America, and the Middle East (*n*=1, respectively) were included. The findings indicate that mucocutaneous manifestations correlate with CD^{4+} levels, with individuals having >500 CD^{4+} cells/µL (seborrheic dermatitis and xerosis), 200–500 cells/µL (opportunistic infections, such as oral candidiasis [31%] and dermatophytosis [8%]), and 200 cells/µL (severe manifestations, such as Kaposi's sarcoma and cryptococcal disease). The prevalence of oral candidiasis ranged from 11.6% to 81.1% and was significantly correlated with CD^{4+} T-cell levels ($p<0.0001$). Cutaneous clinical manifestations consistently appear in immunocompromised individuals and thus have the potential to serve as efficient clinical indicators, particularly in resource-limited settings.

Keywords HIV/AIDS; CD4+; Opportunistic infections; Oral candidiasis; Kaposi's sarcoma; Dermatological manifestations.

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Introduction

Human immunodeficiency virus (HIV) attacks the body's immune system by infecting and depleting CD^{4+} T lymphocytes, which play crucial roles in the body's defense against pathogens.[1] Without adequate treatment, the decline in CD^{4+} cell counts progresses, causing the body to lose its ability to fight infections and become susceptible to certain cancers. The final stage of HIV infection is acquired immunodeficiency syndrome (AIDS), which is characterized by extremely low CD^{4+} counts

accompanied by the development of opportunistic infections or cancers.[2] UNAIDS data show that by the end of 2020, approximately 37.7 million people worldwide were living with HIV.[1,3,4]

Over the past four decades, significant scientific advances and public health efforts have been made; however, HIV/AIDS remains a significant global health burden, with more than 36 million deaths to date. In 2020 alone, approximately 680,000 people died of HIV-related illnesses.[3] Various challenges remain, ranging from the need for sustainable funding for HIV/AIDS programs, stigma and discrimination against people living with HIV/AIDS to limited access to treatment.[3,5,6] The global health community has set an ambitious goal of ending the AIDS epidemic by 2030 through three key objectives: zero new HIV infections, zero discrimination, and zero AIDS-related deaths.[3,6,7] Achieving this goal requires an integrated strategy that simultaneously addresses prevention, treatment, and the elimination of stigma.

Early recognition of the clinical manifestations of HIV/AIDS is the foundation for timely diagnosis and management of the disease. Identifying risk factors for HIV transmission enables the identification of high-risk individuals and the implementation of more effective prevention strategies.[8] Among the various clinical manifestations, cutaneous manifestations have particular clinical significance because they can be observed directly and often serve as early signs of an immune disorder.[2] Approximately 90% of HIV patients are estimated to experience skin manifestations at some point during the course of their illness, including infectious conditions such as herpes zoster and mpox,[8] fungal infections and noninfectious conditions such as psoriasis and Kaposi's sarcoma.[9-11] Dermatological management and early clinical detection have been proven to improve the quality of care and quality of life for individuals.[12,13]

Based on this information, this comprehensive review aims to synthesize the evidence and analyze the patterns of the incidence of skin manifestations, correlations with CD^{4+} levels, and public health implications. The findings of this review are expected to serve as a reference for healthcare professionals and policy makers in designing strategies to address the dermatological needs of patients with HIV/AIDS and identify knowledge gaps that require further research. This review covers skin conditions commonly encountered in HIV infection, their implications for patient care, and evidence-based public health interventions to improve outcomes for individuals living with HIV/AIDS.

Methods

A systematic literature search was conducted in five databases (PubMed/MEDLINE, Scopus, Web of Science, *Garba Rujukan Digital* (GARUDA), and Google Scholar), with the latter specifically for articles in Indonesia covering publications indexed between January 2009 and March 2024.[14,15.] Keyword combinations were constructed using Boolean operators (AND, OR) as follows:[16] (“cutaneous manifestations” OR “skin manifestations” OR “dermatological conditions”) AND (“HIV” OR “AIDS” OR “HIV/AIDS”) AND (“prevalence” OR “epidemiology” OR “incidence”) AND (“opportunistic infections” OR “public health”). Additional relevant articles were identified through a manual search of the reference lists of the included studies and through citation tracking.

The eligibility criteria established in this review were as follows: (1) original research; (2) studies in English; (3) published between 2009 and 2024; (4) studies presenting information related to cutaneous clinical manifestations in individuals with HIV/AIDS; and (5) observational studies, cross-sectional studies, case series, and case reports with clear diagnostic criteria for identifying HIV/AIDS and cutaneous manifestations. Studies that met the

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selection criteria underwent additional screening to confirm the availability of prevalence data, clinical characteristics, and descriptions of the target population, including immunological parameters and CD^{4+} T-cell levels. The exclusion criteria were reviews, editorials, letters to the editor, correspondence, and others. Studies with unclear methodologies or those that did not provide information relevant to the study were excluded. Three reviewers (IAGLDSP, RPA, and IMDMA) independently conducted the selection process based on the title, abstract, and full text. Disagreements among the reviewers were resolved through discussion until consensus was reached.

Data extraction for this review was conducted using a form developed by the researchers. RPA, CISDI, and RDWW extracted study characteristics, including authors, year, country, study design, and sample size; demographic characteristics, including age, sex, HIV stage, and CD4+ levels; and reported prevalence and types of cutaneous manifestations, including clinical characteristics, diagnostic methods used, and identification of the study setting for implications. Study quality was assessed using two instruments, the Newcastle–Ottawa Scale and the JBI Critical Appraisal Checklist, depending on the study type. The evaluation criteria included selection bias, comparability, and outcome assessment. Cohen's kappa coefficient was used to assess reliability, and any disagreements among researchers were resolved through discussion until a consensus was reached.

All extracted data regarding research trends were examined in terms of prevalence rates, geographic variations, reported patterns of cutaneous clinical manifestations, and immunological correlations with cutaneous manifestations in patients with HIV/AIDS and are presented in descriptive and narrative formats. All the quantitative and qualitative data are presented in tabular summaries to identify patterns of correlation among the variables. This study did not perform a meta-analysis because of high heterogeneity and because some variables did not meet the eligibility criteria.

Results

A literature search across all the databases yielded 4,700 initial records, comprising 4,500 records from electronic databases and 200 from other sources. After removing duplicates (*n*=3,600), articles not in English or Indonesian (*n*=60), and those for other reasons (*n*=37), 1,003 records remained for screening. Of these, 823 records were excluded because the full texts were inaccessible, leaving 180 articles for full eligibility assessment. The full-text assessment excluded 164 articles, with the following breakdown: not focused on HIV/AIDS (*n*=86), did not present specific data on cutaneous manifestations (*n*=67), and were review articles (*n*=11). Ultimately, 16 studies met the inclusion criteria and were included in the final analysis. These studies spanned 2009–2024 across various geographic regions and employed diverse methodological approaches, providing a comprehensive overview of the cutaneous manifestations in patients with HIV/AIDS. A PRISMA flow diagram is presented in **Figure 1**.

In this review, sixteen studies (n=16) were reported to originate from Asia (n=9), Africa (n=5), and South America and the Middle East (*n*=1 respectively), published between 2009 and 2024.

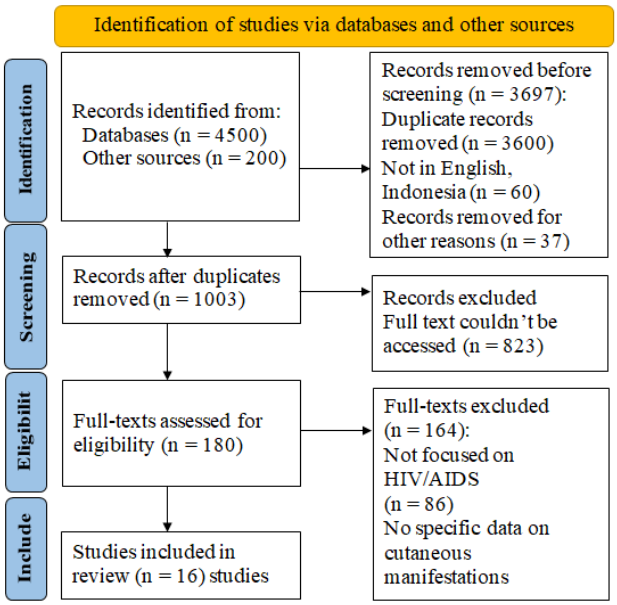

Figure 1 PRISMA flowchart.

In terms of study design, the studies included cross-sectional (*n*=7) and observational (*n*=5) designs, followed by case studies and prospective analyses (*n*=4). The total number of participants was 649. The geographical distribution of the studies included India (*n*=5), China, and Indonesia (*n*=2 respectively). These three regions are countries with a high burden of HIV/AIDS accompanied by widespread dermatological examinations. The characteristics of the included studies are presented in **Table 1.**

The findings of mucocutaneous manifestations based on CD^{4+} thresholds revealed different dermatological patterns corresponding to the degree of immunosuppression, as summarized in **Table 2**. In patients with a CD^{4+} count >500 cells/μL, the predominant conditions are benign disorders such as seborrheic dermatitis, pruritic papular eruptions, and xerosis. In the moderate immunosuppression range (CD^{4+} 200–500 cells/μL), the prevalence of opportunistic infections increases significantly, particularly oral candidiasis (31%), genital herpes (8%), and dermatophytosis (8%). More severe immunosuppression (CD^{4+} 100–200 cells/μL) was significantly correlated with manifestations of herpes zoster ($p<0.05$) and Kaposi's sarcoma ($p=0.03$). In patients with severe immuno suppression with <100 CD^{4+} cells/μL, the manifestations were the most severe, characterized by cryptococcal disease, with a 62.5% mortality rate in the first month, and extensive oral candidiasis strongly correlated with CD^{4+} depletion ($p=0.001$). The number of dermatoses per patient increased significantly as the CD^{4+} count decreased to less than 200 cells/μL ($p<0.05$), reflecting an accumulation of cutaneous burden in line with immunosuppression progression.

This analysis revealed mucocutaneous manifestations that serve as diagnostic and prognostic markers in patients with HIV/AIDS **(Table 3)**. Oral candidiasis was the most commonly observed manifestation, with an incidence ranging from 11.6% to 81.1% across various studies, and was significantly correlated with declining CD^{4+} cell counts ($p<0.0001$). Dermatophytosis was closely associated with moderate immunosuppression ($p<0.001$), particularly in resource-limited settings. Kaposi's sarcoma and cryptococcal disease reflect severe immunocompromised states; specifically, in CrAg-positive patients, the early mortality rate is 62.5%. These findings underscore the need for early dermatological screening as part of the management of patients with HIV/AIDS. Geographical variations in the patterns of skin manifestations indicate that healthcare approaches need to be tailored to regional characteristics, particularly in resource-limited areas where dermatological findings can serve as a cost-effective marker of disease progression. The high prevalence of mucocutaneous manifestations (46.3%–95.2%) in the study population reinforces their potential as clinical markers for monitoring HIV progression and treatment response.

Discussion

A systematic review of 16 studies published between 2009 and 2024 revealed consistent patterns of HIV-associated mucocutaneous manifestations across various geographic regions, with significant implications for clinical practice and patient outcomes. The geographic distribution of the studies revealed a predominance of research from Asia (nine studies) and Africa (five studies), while South America and the Middle East remained underrepresented.[19,25,29,30] This distribution imbalance indicates a research gap that needs to be addressed to obtain a more representative global.

The findings of all the studies indicate an association between CD^{4+} levels and specific types of dermatological manifestations that form a progression pattern and can serve as clinical markers of the disease course. Patients with a CD^{4+} count >500 cells/μL generally present with benign conditions such as seborrheic dermatitis and xerosis,[2,1,31] whereas a decrease in CD^{4+} levels to the range of 200–500 cells/μL is accompanied by an increase in opportunistic infections, particularly oral candidiasis (31%) and dermatophytosis (8%).[10,19,22,25,32]

Table 1 Characteristics of the included studies (sorted on the basis of the year of the studies).

Country (Yr) No. of Authors Research methods	*Article Source*	*Study Populations*	*Result*	*Conclusion*
India; (2009) 11 Hospital-based study	Indian Journal of Dermatology (Indexed in PubMed/MEDLINE, Scopus Q3, DOAJ, etc.)	137 HIV-infected patients attended a tertiary care hospital in a tribal region of Bastar, Chhattisgarh, India.	Among the 137 HIV-infected patients, seborrheic dermatitis (74.16%), xerosis (52.5%), and generalized skin hyperpigmentation (46.67%) were prevalent. A significant correlation with low CD^{4+} counts was observed for oral candidiasis ($P < 0.0001$) and Kaposi's sarcoma ($P = 0.03$).	A high prevalence of dermatological manifestations is associated with CD4 + decline. This finding underscores the need for region-specific healthcare strategies that consider the unique challenges faced by the tribal population..
Brazil (2012) 17 Comparative study	Journal of the American Academy of Dermatology (Indexed in PubMed/MEDLINE, Scopus Q1, Web of Science – SCIE, etc.)	A comparative histopathological and immunohistochemical analysis of 28 HIV-infected patients with pruritic papular eruptions and eosinophilic folliculitis Note: HIV-PPE : Human Immunodefficiency Virus-Pruritic Papular Eruption HIV-EF: human immunodeficiency virus-eosinophilic folliculitis	In a study comparing 18 HIV-PPE and 10 HIV-EF patients, HIV-EF cases exhibited significantly higher levels of perivascular inflammation, increased mast cell counts, and elevated expression of CD15, CD4, and CD7 compared to HIV-PPE cases (all $P < 0.05$).	HIV-PPE and HIV-EF exhibit distinct histopathological and immunohistochemical characteristics. Additional research is necessary to elucidate specific diagnostic and treatment approaches for HIV-associated dermatological conditions.
India (2013) 18 Observational study	Indian Journal of Sexually Transmitted Diseases and AIDS (Indexed in PubMed/MEDLINE, Scopus Q3, Web of Science ESCI, etc.)	352 HIV-positive patients presenting with mucocutaneous manifestations in Northern India.	Among the 352 HIV-positive patients, 76.7% exhibited mucocutaneous manifestations. Candidiasis was the most prevalent condition (16.2%). The number of dermatoses per patient increased as the CD4 + count decreased ($r = -2.33$, $P = 0.001$).	The high prevalence of mucocutaneous manifestations underscores the utility of these as indicators of CD4 decline and advanced immunosuppression. It is noteworthy that regional variations in dermatological conditions necessitate customized HIV and dermatological care strategies.
Nigeria (2014) 19 Observational study	International Journal of Dermatology (Indexed in PubMed/MEDLINE, Scopus Q1, Web of Science – SCIE, etc.)	140 adults with HIV infection or acquired immunodeficiency syndrome attending a hospital in Nigeria.	In a cohort of 140 HIV/AIDS patients, cutaneous manifestations were observed in 77.9% of cases, with oral candidiasis (20.0%) and pruritic papular eruption (19.3%) being the most prevalent conditions. The prevalence of dermatological disorders was significantly and inversely correlated with CD^{4+} cell counts ($P < 0.001$).	Specific cutaneous manifestations are significantly correlated with diminished CD^{4+} lymphocyte counts, underscoring the necessity for targeted dermatological assessments and prompt initiation of antiretroviral therapy to mitigate disease progression and severity..
Indonesia (2013) 20 Descriptive retrospective study	Berkala Ilmu Kesehatan Kulit dan Kelamin (indexed in SINTA 2)	649 HIV/AIDS patients aged 15-65 years	Among 649 adult HIV/AIDS patients (aged 15–65 years) in 2013, 46.3% presented with skin disorders, with the 25–44 age group most frequently affected (70.8%). Oral candidiasis was the predominant condition (81.1%). CD4 + count data were documented for 17.3% of patients, while 31.6% received ART.	Dermatological manifestations are prevalent among individuals with HIV/AIDS, and are predominantly influenced by CD4 + cell count. Oral candidiasis is the most frequently observed mucocutaneous disorder.
Mauritania (2017) 10 Cross-	International Journal of Dermatology (Indexed in PubMed/MEDLINE,	We enrolled 86 adult patients, aged ≥ 18 years, presenting at the Ambulatory Treatment Center of the National Hospital of Nouakchott, Mauritania,	In a study of 86 HIV-positive Mauritanian patients, 64% presented with dermatoses. The most prevalent conditions observed were pruritic papular eruption (44.2%), dermatophyte infections (16.3%), and oral	Dermatoses are common indicators of immunosuppression in Mauritanian HIV patients, facilitating early diagnosis and management. This finding underscores the need for targeted

Country (Yr) No. of Authors Research methods	*Article Source*	*Study Populations*	*Result*	*Conclusion*
sectional study	Scopus Q1, Web of Science – SCIE, etc.)	with newly diagnosed HIV and were not receiving antiretroviral treatment.	candidiasis (11.6%). A statistically significant correlation was found between CD4 + count < 200 cells/mm3 and the occurrence of dermatophytosis (P < 0.00001), candidiasis (P < 0.00000002), Kaposi's sarcoma (P < 0.009), seborrheic dermatitis (P < 0.001), and xerosis (P < 0.04).	dermatological interventions in specific regions (the Mauritanian population).
India (2017) 12 Prospective study	Indian Journal of Sexually Transmitted Diseases and AIDS (Indexed in PubMed/MEDLINE, Scopus Q3, Web of Science ESCI, etc.)	A cohort of 100 HIV-positive patients presenting with cutaneous and mucosal manifestations was selected sequentially. A comprehensive medical history was obtained, a thorough clinical examination was conducted, and the CD4 count was recorded..	In a cohort of 100 HIV-positive patients, 47% exhibited CD4 + count ranging from 201 to 500. The most prevalent infections observed were oral candidiasis (31%), genital herpes (8%), and dermatophytosis (8%). Multiple dermatoses occurred with a significantly higher frequency in patients with CD4 + count < 200 (P < 0.05)..	This study emphasized the paramount importance of early initiation of antiretroviral therapy (ART) and regular dermatological evaluations. Lower CD4 + counts were associated with severe mucocutaneous manifestations.
Sierra Leone (2020) 21 Prospective study	BMC Infectious Diseases (Indexed in PubMed/MEDLINE, Scopus Q1, Web of Science – SCIE, etc.)	We included 170 adult (≥ 18 years) HIV patients with CD4 counts < 100 cells/mm3 from January to April 2018 at Connaught Hospital in Freetown, Sierra Leone.	Among 170 advanced HIV patients, the prevalence of CrAg was 4.7% (95% CI: 2.4–9.2%). Five of the eight CrAg-positive patients also tested positive for CSF cryptococcal antigen (CrAg). The mortality rate of CrAg-positive patients within the first month was 62.5%.	Elevated mortality rates indicate the critical need for systematic CrAg screening and prompt treatment in advanced HIV. Early detection and intervention strategies are essential to mitigate mortality associated with cryptococcal infections.
China (2020) 22 Cross-sectional study	International Journal of Dermatology (Indexed in PubMed/MEDLINE, Scopus Q1, Web of Science – SCIE, etc.)	This retrospective analysis included data from 508 HIV/AIDS patients in Yunnan, China.	Mucocutaneous manifestations were observed in 86% of the 508 HIV/AIDS patients. Herpes zoster and oral candidiasis were associated with CD4 counts <200, whereas eczema exhibited a higher prevalence in patients with CD4 counts ≥200 (p<0.05).	Mucocutaneous manifestations are associated with low CD4 counts; antiretroviral therapy (ART) significantly (p< 0.05) reduces dermatological complications among HIV-positive patients, underscoring the necessity for timely ART initiation.
Iran (2020) 23 Cross-sectional study	Scientifica (Indexed in Pubmed/MEDLINE, Scopus Q2, Web of Science – ESCI, etc.)	84 HIV-positive patients who attended the Behavioral Consultation Center of Arak University of Medical Sciences	In a cohort of 84 HIV-positive patients, 95.2% exhibited mucocutaneous lesions. The prevalent conditions included xerosis (54.8%) and seborrheic dermatitis (54.4%). Oral candidiasis (47.6%, P=0.002) and furuncle (P=0.006) were significantly associated with low CD4+counts.	Early intervention and comprehensive care are essential for managing dermatological conditions in HIV-positive patients, particularly those with lower CD4 counts, which may lead to more severe manifestations.
India (2021) 2 Observational study	Cureus (Indexed in PubMed/MEDLINE)	A cohort of 253 patients undergoing treatment for HIV/acquired immunodeficiency syndrome (AIDS) at the ART Center (anti-retroviral therapy center) in Rajkot city, Gujarat, India from 2011 to 2019 were included in the study.	In a study of 253 HIV patients, 89.72% exhibited dermatologic opportunistic infections (OIs): fungal (33.03%), bacterial (28.18%), viral (14.55%), and herpes (10.57%), predominantly in stage 2 with CD4 counts ranging from 371 to 410..	Dermatologic OIs are correlated with disease stage and CD4 + count, which is crucial for clinical assessments in resource-limited settings. This underscores the importance of thorough dermatological evaluations in HIV-infected individuals..
Indonesia (2022)	Bali Medical Journal (indexed in SINTA 1	614 HIV/AIDS patients, 149 met inclusion criteria	Among 614 HIV/AIDS patients, 149 met the inclusion criteria. Most were men (74.5%) and aged 25–49 years	Specific mucocutaneous manifestations, including pyoderma, syphilis, and candidiasis,

Country (Yr) No. of Authors Research methods	*Article Source*	*Study Populations*	*Result*	*Conclusion*
24 Analytical retrospective cross-sectional study	and Scopus Q4)		(70.5%). Heterosexual transmission was identified as the primary risk factor (48.3%). CD4 counts below 200 cells/mm^3 were observed in 64.4% of the cases. Infections constituted 55.8% of the total cases..	may serve as indicators of advanced immunosuppression (low CD4 levels).
India (2023) 25 Cross-sectional study	Indian Journal of Sexually Transmitted Diseases and AIDS (Indexed in PubMed/MEDLINE, Scopus Q3, Web of Science ESCI, etc.)	A cross-sectional study was conducted in 250 people living with HIV (PLHIV) who fulfilled the inclusion and exclusion criteria.	Among 250 PLHIV, 364 dermatoses were observed. Infectious etiologies were predominant (77.6%), with dermatophytosis (27.2%) being the most prevalent. Statistically significant associations were found between CD4 count and dermatophytosis ($p \leq 0.001$) and candidiasis ($p = 0.001$).	Dermatological manifestations are significantly correlated with CD4 + count, highlighting the role of these markers in assessing immune status in PLHIV. Integrated HIV care encompassing dermatological assessments is needed to effectively manage skin diseases.
Madagascar (2023) 26 Cross-sectional study	JMIR Dermatology (Indexed in PubMed/MEDLINE, Scopus Q3, etc.)	A total of 328 patients attending the Department of Infectious Diseases at the University Hospital of Antananarivo in Madagascar were enrolled in this study, which was conducted from January 2013 to March 2020..	In a cohort of 328 HIV-positive patients, 51% exhibited mucocutaneous lesions. Oral candidiasis (48.2%) was the most prevalent manifestation. Significant correlations were observed between CD4 + count decreases and oral candidiasis ($P = 0.001$), syphilis ($P = 0.002$), and condyloma acuminatum ($P = 0.03$)..	Oral candidiasis, syphilis, and condyloma acuminatum serve as significant indicators of declining immune function in patients with HIV infection. This underscores the importance of socioeconomic status and healthcare accessibility in the management of dermatological conditions in individuals with HIV infection..
United Arab Emirates (2024) 27 Cross-sectional study	Journal of Fungi (Basel, Switzerland) (Indexed in PubMed/MEDLINE, Scopus Q1, Web of Science – SCIE, etc.)	There is a broad population of UAE residents, with estimates focusing on groups at elevated risk of serious fungal infections (approximately 228,695 affected individuals).	In the United Arab Emirates (UAE), recurrent vulvovaginitis (approximately 190,000 cases) and fungal asthma (approximately 34,000 cases) are prevalent. Annual cases include cryptococcal meningitis (2), Pneumocystis pneumonia (PCP) (165), esophageal candidiasis (20), pulmonary aspergillosis (1002), invasive aspergillosis (505), and candidemia (1090; 49.2% in intensive care units)..	Fungal diseases affect approximately 228,695 individuals, or 2.46% of the United Arab Emirates population. This prevalence underscores the need for customized public health interventions to address fungal diseases..
China (2024) 28 Case study	BMC Infectious Diseases (Indexed in PubMed, Scopus)	A 50-year-old male patient presenting with acquired immunodeficiency syndrome (AIDS), multidrug-resistant pulmonary tuberculosis (MDR-PTB), and chronic hepatitis B virus (HBV) infection.	In a case study of a 50-year-old individual with acquired immunodeficiency syndrome (AIDS) presenting with multidrug-resistant pulmonary tuberculosis (MDR-PTB), hepatitis B virus (HBV)-related liver failure, and disseminated cryptococcal infection, treatment complications included immune reconstitution inflammatory syndrome (IRIS). Notwithstanding initial challenges, the patient demonstrated recovery following appropriate clinical management.	Enhancing medical adherence and comprehensive infection assessments prior to antiviral therapy are crucial for preventing HBV reactivation and IRIS in patients with AIDS. This approach highlights the challenges in treating multimorbid conditions in patients with HIV and necessitates multifaceted and targeted treatment strategies.

Table 2 Pattern of mucocutaneous manifestations stratified by CD^{4+} T-cell count thresholds.

CD^{4+} count range (cells/µL)	*Common mucocutaneous diseases*	*References*
>500	Seborrheic dermatitis, Pruritic papular eruptions, Eczema, Xerosis	11,22,25
200-500	Oral candidiasis, Genital herpes, Dermatophytosis	2,12,20,24,25
100-200	Herpes zoster, Kaposi's sarcoma, Seborrheic dermatitis	10,19,22
<100	Cryptococcal disease, PCP (Pneumocystis pneumonia), Severe pruritic papular eruptions, Extensive oral candidiasis	12,19,21,24

Table 3 Key diagnostic mucocutaneous manifestations associated with HIV/AIDS.

Mucocutaneous manifestation	*Description and Clinical Significance*	*References*
Oral candidiasis	White patches on the tongue and mucous membranes; common in low CD^4+ counts	10,11,24,26
Kaposi's sarcoma	Purplish lesions on the skin and mucous membranes; indicates advanced immunosuppression	10,18
Pruritic papular eruptions	Itchy papules commonly found in HIV patients; more severe with lower CD^4+ counts	19,26
Herpes zoster	Painful vesicular rash usually in a dermatomal distribution; common with moderate to low CD^4+ counts	12,22
Dermatophytosis	Fungal infections of the skin, hair, or nails; often seen with moderate to severe immunosuppression	10,12
Seborrheic dermatitis	Greasy scales and erythematous patches, particularly on the scalp and face	11,19
Cryptococcal disease	Skin lesions can mimic molluscum contagiosum or umbilicated papules; indicates severe immunosuppression	21,28
Xerosis	Dry, scaly skin; common but more severe with lower CD4 counts	11,23
Genital herpes	Painful vesicular lesions on genitalia; more frequent with declining CD4 counts	12
Extensive oral candidiasis	Severe white patches in the oral cavity; indicates significant immunosuppression	12,21

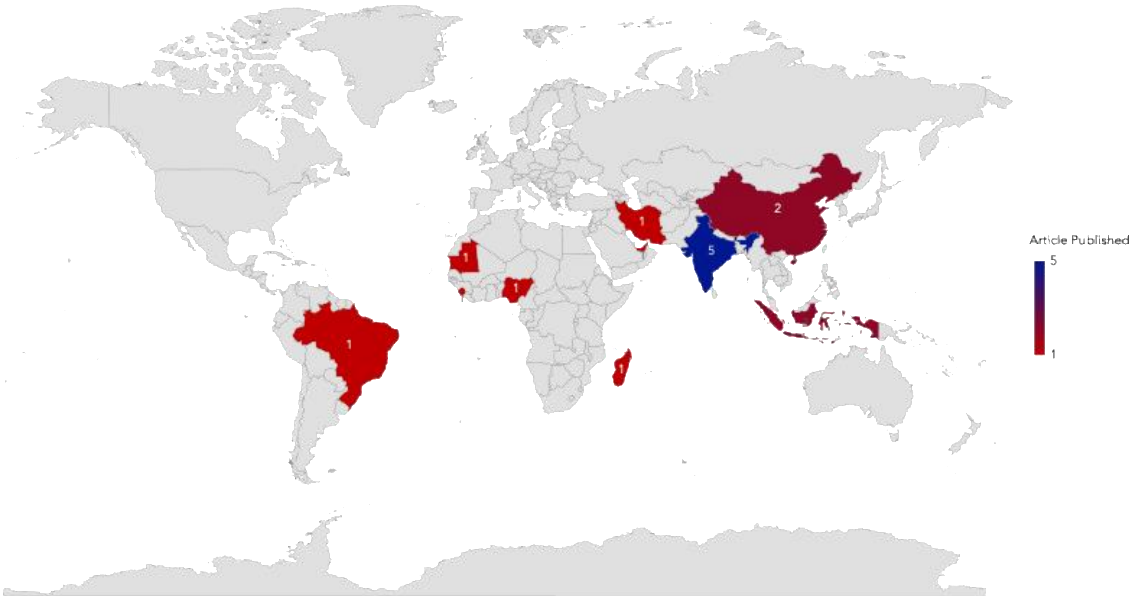

Figure 2 Distribution of included studies. Remarks: India: five studies; China: two studies; Indonesia: two studies; Iran, United Arab Emirates, Madagascar, Nigeria, Mauritania, Sierra Leone, and Brazil: one study each. Maps were created using Microsoft Excel® powered by Bing.

This stratification model allows healthcare providers to estimate a patient's immunological status on the basis of visible clinical skin findings without relying entirely on laboratory tests.

Severe immunosuppression with CD^{4+} counts in the range of 100–200 cells/μL was significantly associated with herpes zoster ($p<0.05$) and Kaposi's sarcoma ($p=0.03$),[9] whereas severe immunosuppression with CD^{4+} counts of 100 cells/μL led to the most severe manifestations, including cryptococcal disease, with an early mortality rate of 62.5%.[21,28] Oral candidiasis has consistently been identified as a key diagnostic indicator in various studies, with a prevalence range of 11.6–81.1% and a significant correlation with CD^{4+} depletion ($p<0.0001$).[20,23] These findings are particularly relevant in healthcare facilities with limited resources, where dermatological manifestations can serve as practical and cost-effective markers of disease progression without the need for expensive diagnostic tests.[33-36]

Geographical variations in the patterns of cutaneous manifestations are also important and necessitate different healthcare approaches in one region to another. A study from India reported a high prevalence of seborrheic dermatitis (74.16%) and xerosis (52.5%),[20,29,36] whereas a study in Mauritania revealed a different pattern, with pruritic papular eruptions (44.2%) as the dominant manifestation.[10] These differences in patterns indicate the influence of environmental, genetic, and healthcare accessibility factors on the clinical presentation of the disease.[21] Therefore, universal clinical guidelines need to be adapted to local conditions to be implemented more effectively.

From a clinical perspective, identifying specific manifestations as early warning signs of impaired immunity has a direct impact on the timing of intervention. Dermatophytosis is strongly associated with moderate immunosuppression ($p\leq0.001$),[9] whereas Kaposi's sarcoma and cryptococcal disease are indicators of severe immunosuppression with high mortality rates in CrAg-positive patients.[21,28] Evidence from various studies supports the implementation of an integrated care model that combines HIV management with dermatological services, leading to early detection of disease progression and improved overall patient outcomes.[37-39] Comprehensive management has been clinically proven and can be implemented in regions with a high burden of HIV/AIDS and limited resources. The dermatological profile, as assessed by clinical manifestations, can serve as a tool for measuring disease progression and treatment response.[40-44]

Public health and clinical implications

The public health and clinical implications of these findings highlight the importance of comprehensive dermatological screening as a standard of care for HIV/AIDS to minimize the incidence and severity of skin diseases. The high incidence and clinical manifestations of cutaneous involvement in this population indicate that care and treatment should include monitoring CD^{4+} counts alongside early skin examinations. The correlation between cutaneous manifestations and CD^{4+} counts suggests that this component can serve as a clinical indicator or marker related to disease progression, immunological status, and the occurrence of opportunistic infections and other conditions; certainly, this method is cost effective, safe, and applicable in regions with limited access to laboratories and resources. Variability in manifestation patterns indicates that global clinical guidelines require significant adaptation to local epidemiological, environmental, and social conditions. Disease management is more effective when it is tailored to each specific region.

Limitations

The limitations identified in this study include the heterogeneity of the studies, which precluded the performance of a meta-analysis. Consequently, the strength of the evidence could not be statistically confirmed. Variability in the reporting of prevalence data and clinical manifestations made it difficult to

collect quantitative information, particularly when a meta-analysis was conducted. The limited number of longitudinal studies assessing the relationship between cutaneous manifestations and CD^{4+} counts means that temporal correlations cannot be identified. The uneven geographical distribution of the studies limits the global generalizability of the findings.

Conclusions

This comprehensive review confirms that clinical cutaneous manifestations correlate with CD^{4+} cell counts as markers of immunological status, disease progression, and treatment success in individuals with HIV/AIDS. The observed clinical presentation patterns are closely linked to the degree of immunosuppression and immunological status, making them useful in settings or regions with limited resources and laboratory capabilities. This review provides new evidence that the routine integration of dermatological screening into HIV care protocols is necessary; however, healthcare approaches must be tailored to the epidemiological and social conditions of each region. Overall, these findings support the development of a comprehensive care model that incorporates periodic dermatological assessments as a component of HIV care to minimize failures in identifying early-stage HIV/AIDS progression. Longitudinal and prospective studies are needed in the future to elucidate the role of CD^{4+} cells in disease progression and the emergence of dermatological manifestations on the basis of the duration of care and treatment.

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Author's contribution

IAGLDSP: Conceived the review, designed the literature search, conducted the literature search, screened the results of the searches, assessed the quality of the included studies, abstracted the data from the included studies, performed formal analysis, curated the data, and wrote the original draft.

CSIDI, RDWW: Conducted the literature search (investigation), assisted in data curation, and contributed to software development, Writing original draft

FAZZ: Investigation, project administration, writing, review and editing.

MKM: Contributed to the visualization of the data and results and critical review of the manuscript.

RP: Contributed to writing the original draft; reviewing, editing, and supervising the research process; and critically reviewing the manuscript.

IMDMA: Performed the validation, formal analysis, visualization of the data and results, writing–review & editing, and critical review of the manuscript

RPA: Conceived the review, designed the methodology, validated the findings, curated the data, provided supervision, and contributed to writing-review & editing, manuscript writing and critical review.

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