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Review Paper

Artificial Intelligence in the Assessment and Management of Psychiatric Comorbidities in Psoriasis: A Comprehensive Review

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ABSTRACT

Psoriasis is a chronic, immune-mediated inflammatory skin disease affecting approximately 2–4% of the global population. Beyond its cutaneous manifestations, psoriasis is strongly associated with a spectrum of psychiatric comorbidities including depression, anxiety, suicidal ideation, and substance use disorders, mediated through shared neuro-inflammatory pathways involving cytokines such as IL-6, IL-17, and TNF- α . Objective: This review systematically evaluates the role of artificial intelligence (AI) — including machine learning, deep learning, natural language processing, and large language models — in the identification, prediction, and management of psychiatric comorbidities in psoriasis patients. Methods: A comprehensive literature search was conducted across PubMed, Embase, Scopus, IEEE Xplore, and Google Scholar from inception to June 2025. Studies employing AI methodologies in the context of psoriasis with psychiatric or psychosocial outcomes were included. Results: AI applications span biomarker discovery for comorbid anxiety-psoriasis phenotypes, machine learning-based prediction of quality of life (DLQI), identification of patients at risk of depression using electronic health records, and AI-powered digital health tools for mental health monitoring. Key findings include the identification of 13 shared diagnostic biomarkers between psoriasis and anxiety disorders via ML, Random Forest models demonstrating psychological stress as the primary predictor of QoL over PASI scores, and EHR-based SVM models achieving AUC of 0.83 for early biologic therapy prediction. Conclusions: AI holds transformative potential for integrating psychiatric screening into routine psoriasis care. However, challenges remain including data standardisation, algorithm validation, and ethical concerns around patient privacy. Future research must prioritise diverse, prospective datasets and explainable AI frameworks to enable clinical translation.

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INTRODUCTION

Psoriasis is a chronic, systemic, immune-mediated inflammatory condition affecting approximately 2–4% of the global population [1]. Historically regarded primarily as a dermatological disease, contemporary evidence has repositioned psoriasis as a multisystem disorder with profound implications for cardiovascular health, metabolic function, musculoskeletal integrity, and — most pertinently — mental health [2, 3].

The burden of psychiatric comorbidities in psoriasis is substantial and underrecognised. Epidemiological data indicate that the prevalence of depression among adults with psoriasis reaches approximately 20%, while anxiety disorders affect around 21% [4]. Suicidal ideation, historically underreported, has been documented in up to 44% of patients with severe disease, with suicide attempt rates ranging from 2.5% to 9.7% [5, 6]. These figures markedly exceed those seen in age- and sex-matched general populations, underscoring the disproportionate psychiatric burden borne by psoriasis patients.

The pathophysiological substrate linking psoriasis to psychiatric illness is increasingly understood through the lens of neuroinflammation. Shared cytokine networks — particularly involving interleukin-6 (IL-6), interleukin-17 (IL-17), and tumour necrosis factor-alpha (TNF- α) — appear to bridge cutaneous inflammation with neurobiological disruption, activating the hypothalamic-pituitary-adrenal (HPA) axis, perturbing serotonergic neurotransmission, and inducing hippocampal neuroinflammation [7, 8]. This bidirectional relationship implies that psychiatric morbidity not only arises from psoriasis but may in turn exacerbate inflammatory disease activity, creating a self-perpetuating cycle of physical and psychological deterioration.

Despite the clinical significance of psychiatric comorbidities, systematic mental health screening

remains inconsistently implemented in dermatological practice. The assessment gap is attributable to time constraints in outpatient settings, the absence of standardised multidisciplinary care pathways, and a historical tendency to regard psychological symptoms as secondary to skin disease rather than integral to its management [9].

Against this backdrop, artificial intelligence (AI) has emerged as a potentially transformative technology in dermatology and beyond. AI — encompassing machine learning (ML), deep learning (DL), natural language processing (NLP), and large language models (LLMs) — offers capabilities for pattern recognition at scale, predictive modelling using complex multivariable datasets, and automated surveillance that extend well beyond the capacity of conventional clinical assessments [10, 11]. The application of AI to the psoriasis-psychiatry interface represents a nascent but rapidly evolving field with significant clinical promise.

This review systematically synthesises the current state of AI-based approaches applied to the recognition, prediction, and management of psychiatric comorbidities in psoriasis. We examine the epidemiology and pathophysiology of the psoriasis-psychiatry nexus, review available AI methodologies and their specific applications, discuss quality-of-life measurement using AI tools, and critically appraise the challenges and future directions in this domain.

Epidemiology of Psychiatric Comorbidities in Psoriasis

Prevalence and Incidence

The epidemiological evidence linking psoriasis to psychiatric disorders is extensive and consistent across geographic regions, though with notable variation in reported rates reflecting differences in



study design, diagnostic criteria, and healthcare system context [4].

A large-scale meta-analysis synthesising data from 56 studies across five international databases reported a pooled prevalence of depression of 20% and anxiety of 21% in adults with psoriasis. Incidence rates reached 42.1 cases of depression and 24.7 cases of anxiety per 1,000 person-years — rates substantially higher than background population estimates [4]. Critically, patients in North America demonstrated the highest rates of depression and suicide, while anxiety was most prevalent in South American cohorts, suggesting regional healthcare, cultural, and socioeconomic factors modulate psychiatric burden.

A cross-sectional study of 316 patients with histopathologically confirmed psoriasis, conducted between 2021 and 2025, found that 27.8% had at least one psychiatric or behavioural comorbidity. Tobacco use disorder (11.1%) and alcohol use disorder (9.2%) were the most common diagnoses overall, followed by binge eating disorder (7.9%), anxiety (6.3%), and depression (4.1%). Additional diagnoses encompassed personality disorders, post-traumatic stress disorder, dementia, and sleep disorders [12]. The prevalence of suicidality in psoriasis is particularly concerning. A tertiary-centre cross-sectional study found lifetime suicidal ideation in 48.8% of psoriasis patients, suicidal planning in 21.3%, and suicide attempts in 9.4% [6]. Crucially, psoriatic arthritis (PsA) co-occurrence was independently associated with depression (adjusted odds ratio 2.92, 95% CI 1.53–5.68), indicating that joint disease significantly amplifies psychiatric burden [6].

Bidirectionality of the Psoriasis-Psychiatry Relationship

Evidence from Mendelian randomisation studies supports a bidirectional causal relationship between psoriasis and psychiatric conditions

including depression, anxiety, and suicidality [13]. Psychiatric disorders may both arise as consequences of chronic skin disease and independently precipitate or worsen psoriatic inflammation, suggesting that psychological stress acts as a biological mediator of cutaneous disease activity rather than merely a reaction to it [7, 13]. A workshop convened by the International Psoriasis Council in Barcelona identified neuroinflammation as the mechanistic bridge connecting psoriasis and depression, with evidence that sleep disruption further compounds cardiovascular and psychiatric risk [8]. The Skin-Brain Axis concept — encompassing inflammatory, neuroendocrine, hormonal, microbiome-mediated, and neuropeptide pathways — has emerged as the overarching conceptual framework for understanding this bidirectional relationship [14].

Pathophysiology: The Neuroinflammatory Nexus

Shared Cytokine Pathways

The mechanistic basis for psychiatric comorbidity in psoriasis resides predominantly within shared inflammatory networks. Cytokines central to psoriatic pathogenesis — particularly IL-17, IL-23, and TNF- α — exert neurotoxic effects when they cross the blood-brain barrier or stimulate peripheral immune cells with central nervous system access [7, 15].

TNF- α , a key effector in both plaque psoriasis and synovial inflammation in PsA, activates microglial cells and induces neuroinflammation, contributing to neuronal synaptic dysfunction and cognitive impairment [15]. Serum levels of TNF- α and IL-17A have been found to independently predict increased depressive symptoms in longitudinal cohort studies [16]. IL-6, a pleiotropic cytokine elevated in psoriatic skin and systemically, stimulates the HPA axis and promotes serotonin



transporter upregulation, thereby reducing synaptic serotonin availability and increasing vulnerability to depressive illness [7].

The kynurenine pathway, activated by systemic inflammation, is increasingly recognised as an important neuroimmunological mediator. Elevated IDO-1 enzyme activity — driven by inflammatory cytokines including TNF- α and IFN- γ — diverts tryptophan away from serotonin synthesis towards the production of neurotoxic quinolinic acid, implicating this pathway in the pathogenesis of inflammation-associated depression and suicidality in psoriasis [14, 17].

Brain Structural and Connectivity Changes

Advanced neuroimaging studies have begun to characterise structural brain changes associated with psoriasis and its psychiatric comorbidities. An investigation utilising UK Biobank neuroimaging data — representing the largest psoriasis neuroimaging cohort to date — demonstrated alterations in brain structure and functional connectivity in psoriasis patients, with effects modulated by depression comorbidity and systemic inflammation. Patients with PsA, reflecting a higher inflammatory burden, exhibited more pronounced neuroimaging abnormalities, supporting the hypothesis of immune-mediated crosstalk between skin, joints, and brain [18].

These structural findings provide a neurobiological basis for observed cognitive impairment, anhedonia, and emotional dysregulation in psoriasis patients with comorbid psychiatric disorders — manifestations that may be inadequately captured by conventional PASI-based severity scoring but which AI-enabled multidimensional assessments are positioned to detect and quantify.

Artificial Intelligence: Concepts and Methodological Framework

Definitions and Core Concepts

Artificial intelligence refers to the simulation of human cognitive functions — including reasoning, learning, and problem-solving — by computational systems [10]. In clinical medicine, AI most commonly manifests as machine learning: the capacity of algorithms to learn patterns from data without explicit programming, progressively improving their predictions as more data are processed [10, 19].

Deep learning, a subfield of ML, employs multi-layered artificial neural networks to model high-dimensional data representations, and has demonstrated dermatologist-level or superior performance in image-based skin disease classification tasks [20, 21]. Natural language processing enables computational analysis of unstructured clinical text — including electronic health records, consultation notes, and patient-reported outcomes — to extract clinically meaningful information [22]. Large language models, exemplified by contemporary generative AI systems, extend NLP capabilities to contextual reasoning, knowledge synthesis, and conversational interaction [22].

AI Methodologies Applied in Dermatology and Psychiatry

The principal AI methodologies relevant to the psoriasis-psychiatry interface include:

- Supervised ML algorithms (Support Vector Machines, Random Forests, Gradient Boosted Trees, Logistic Regression) trained on labelled clinical datasets to predict outcomes such as depression status, treatment response, or QoL impairment.
- Convolutional Neural Networks (CNNs) and transformer-based architectures for image analysis — enabling automated PASI scoring, lesion segmentation, and phenotype classification from clinical photographs.



- Ensemble models combining multiple learners to improve predictive robustness across diverse patient populations.
- NLP pipelines applied to electronic health records (EHRs) to identify psychiatric diagnoses, medication patterns, and patient-reported outcomes at population scale.
- Multimodal AI systems integrating imaging, genomic, clinical, and patient-reported data streams for holistic disease characterisation.
- Digital health AI incorporating wearable sensors, mobile applications, and chatbot interfaces for real-time psychiatric symptom monitoring.

AI Applications in Psoriasis Diagnosis and Severity Assessment

Deep Learning for Lesion Classification

The development of AI-driven psoriasis image analysis has advanced considerably over the past decade. A CNN trained on dermoscopic psoriasis images demonstrated performance comparable to a panel of 230 dermatologists in classifying papulosquamous skin diseases, illustrating that deep learning can approach expert-level diagnostic accuracy in controlled evaluation settings [20].

Eskandari and Sharbatdar (2024) developed a customised 50-layer ResNet-50 architecture with advanced data augmentation and class balancing for differentiating psoriasis from lichen planus — conditions sharing striking morphological similarity. The model achieved an accuracy of 89.07%, sensitivity of 86.46%, and specificity of 86.02% [45].

For severity quantification, ResNet50-based models applied to standardised clinical images have achieved accuracy of 92.50% (95% CI: 91.2–93.8%), with precision of 93.10% and F1-score of 92.68%, in classifying disease severity across PASI categories including clear, mild, and moderate-to-severe disease [42]. A deep learning

system evaluated on clinical trial imaging data demonstrated concordance with clinician PASI scoring (Pearson $r = 0.90$), suggesting readiness for potential real-world deployment [47].

Automated PASI Scoring

The Psoriasis Area and Severity Index, while remaining the gold standard for severity assessment, is subject to significant inter-rater variability and requires specialist expertise. AI-based automated PASI scoring addresses both limitations. A real-world study and application published in the *Journal of Medical Internet Research* (2023) demonstrated that AI-based psoriasis severity assessment performed robustly across diverse clinical settings, paving the way for consistent, objective severity evaluation in primary care and telemedicine contexts [19].

A systematic review of 30 studies assessing ML in psoriasis severity prediction — the most comprehensive analysis to date — found that image-based models predominated, with PASI as the most commonly used outcome measure. The review highlighted that non-image-based applications, including psychiatric comorbidity risk prediction, remain underexplored and represent an important frontier for future investigation [3].

AI in the Detection and Prediction of Psychiatric Comorbidities

Biomarker Discovery for Comorbid Psoriasis and Anxiety Disorders

One of the most significant contributions of AI to the psoriasis-psychiatry interface has been in the domain of molecular biomarker discovery. Flygare and colleagues employed five machine learning algorithms — trained on Gene Expression Omnibus (GEO) database data — to identify four biomarkers predictive of both psoriasis and



anxiety disorder from an initial panel of 16 candidate genes [9, 23].

ROC curve analysis confirmed the predictive capability of these biomarkers in both training and validation datasets. Single-cell RNA sequencing further highlighted the role of the CASP7 gene — implicating T cell development and immune regulation — in mediating the psoriasis-anxiety phenotype. These findings suggest that anxiety may operate through skin inflammation pathways involving autophagy and immune dysregulation, and offer the prospect of targeted biomarker-guided therapeutic strategies for patients with comorbid disease [9, 23].

In a parallel bioinformatics study using machine learning, 13 diagnostic genes shared between psoriasis and anxiety disorders were identified, providing molecular validation of the clinical observation that these conditions co-occur at rates exceeding chance [24]. Such multi-gene biomarker panels could ultimately inform stratified risk classification tools that identify psoriasis patients most vulnerable to psychiatric decompensation.

Machine Learning for Quality of Life Prediction

Health-related quality of life (HRQoL), operationalised through the Dermatology Life Quality Index (DLQI), integrates both physical and psychological disease burden. Given the strong association between psychiatric comorbidity and DLQI impairment, ML-based QoL prediction models offer a promising surrogate approach to psychiatric risk stratification.

A landmark Thai study employed penalised regression and ML approaches — including Random Forest (RF), Lasso, Ridge, and Elastic Net regression — to predict DLQI in psoriasis patients. The RF decision-tree model identified psychological stress indicators as the strongest predictors of QoL impairment, outweighing PASI

scores, patient age, and clinical comorbidities in predictive importance [8, 16]. This finding has profound clinical implications: it positions psychological distress — not objective disease severity — as the primary determinant of perceived QoL, reinforcing the case for routine mental health screening integrated into clinical algorithms.

The study also identified gender-related differences in predicted QoL scores, with women demonstrating better predictions, and noted that older age correlated with lower DLQI scores, potentially reflecting greater psychological resilience or adapted expectations among older psoriasis patients [16]. Notably, the authors explicitly advocated for the incorporation of mental health screening for stress, depression, and anxiety alongside physical assessments — underscoring the clinical significance of their AI model's findings.

Earlier work by Emam and colleagues, analysing data from 681 psoriatic patients within the Danish DERMBIO registry, compared six modelling approaches — including generalised linear models (GLM), SVM, decision trees, random forests, gradient-boosted trees, and deep learning — in predicting long-term biologic treatment response using DLQI and PASI as predictors. The GLM outperformed more complex architectures in overall classification accuracy and in predicting reasons for treatment discontinuation, illustrating that model complexity does not always confer superior clinical performance [31].

EHR-Based Prediction of Psychiatric Risk

Electronic health records represent a rich but underutilised resource for psychiatric risk stratification in psoriasis. A retrospective ML study using EHR data from Clalit Health Services in Israel — one of the largest integrated healthcare providers globally — evaluated KNN, SVM, Random Forest, and Logistic Regression models



to predict future biologic therapy need in psoriasis patients, incorporating clinical demographics, comorbidities, treatment history, and laboratory results.

The SVM model, trained on data from the first five years post-diagnosis, achieved an AUC of 0.83 with a recall of 0.70. A Random Forest model using the five-year period preceding biologic initiation achieved an AUC of 0.93 with recall of 0.95. Key predictors included comorbid immune-mediated conditions, topical treatment frequency, and metabolic-inflammatory markers — suggesting that psychiatric comorbidities, through their inflammatory contributions, may be implicitly embedded in predictive feature importance even when not explicitly modelled [29].

The incorporation of psychiatric variables including depression diagnosis codes, anxiolytic prescriptions, and PHQ-9 scores as EHR features into future predictive models represents a logical next step — one enabled by the increasing availability of structured mental health data within integrated care records and AI-driven data linkage platforms.

Treatment Outcome Prediction Incorporating Psychological Variables

The interaction between psychiatric status and treatment response in psoriasis is clinically significant but incompletely understood. A comprehensive ML study by Schaffert and colleagues analysed data from 309 psoriasis and PsA patients and constructed predictive models for treatment change, identifying QoL changes as among the most important determinants of treatment trajectory — alongside initial PASI and diagnostic scores at treatment initiation [13].

In the domain of psychodermatology specifically, Curtiss and colleagues applied Support Vector Machine models with 10-fold cross-validation to predict treatment outcomes for body dysmorphic

disorder in 97 patients receiving escitalopram. The models achieved AUCs of 0.77, 0.75, and 0.79 for treatment response, partial remission, and full remission respectively. Crucially, lower DLQI scores and reduced hopelessness were identified as the strongest predictors of favourable outcomes — directly implicating the dermatology-psychiatry interface in treatment efficacy [9].

AI, Quality of Life, and Psychosocial Impact Monitoring

Chronic inflammatory skin disease imposes a profound psychosocial burden that extends beyond clinical severity metrics. The DLQI — a validated 10-item patient-reported outcome measure — captures the impact of skin disease on daily life, emotional functioning, and social engagement [16]. However, traditional single-timepoint DLQI assessment provides only a cross-sectional snapshot, missing the dynamic fluctuations in psychological status characteristic of relapsing-remitting psoriasis.

ML-powered longitudinal QoL monitoring represents a paradigm shift in this regard. By incorporating stress indicators, mood-related patient-reported data, and real-time symptom tracking from mobile health applications into predictive algorithms, AI systems could deliver continuous, personalised QoL assessment — enabling timely clinical intervention before psychiatric decompensation occurs [16, 28].

Several digital applications have been validated for psoriasis management and mental health monitoring. SymTrac Psoriasis enables photograph-based symptom and QoL tracking; Claro and Kopa provide emotionally-focused wellness support; while MiPsoriasis monitors disease burden through questionnaires [34]. These platforms represent the infrastructure upon which AI-driven psychiatric risk surveillance systems could be built — with NLP-analysed patient



narratives, sentiment analysis, and predictive algorithms working in concert.

A scoping review of AI-driven digital interventions in mental health care, synthesising 36 empirical studies published through January 2025, documented the effective deployment of conversational AI agents, NLP tools, and ML models for mental health screening, therapeutic support, and longitudinal monitoring [35]. The application of analogous technologies to the psoriasis population — characterised by high psychiatric vulnerability — is a natural and overdue extension.

AI for Early Detection of Specific Psychiatric Comorbidities

Depression

Depression co-occurring with psoriasis tends to be more severe than depression in the general population, with higher rates of suicidal ideation and greater functional impairment [5]. Despite this, under-detection in dermatology settings remains prevalent. AI offers multiple pathways to close this detection gap.

NLP algorithms applied to clinical consultation records can flag depressive language patterns, pessimistic self-referential statements, and sleep disturbance complaints that may not trigger formal psychiatric referral under current practice models [22, 35]. ML classifiers trained on combined clinical, demographic, and patient-reported outcome data can identify patients meeting criteria for probable depression using structured data that already exists within EHR systems — without requiring additional clinician time [29].

In a broader mental health context, SVM models trained on DASS-42 questionnaire data achieved accuracy of 99.3%, 98.9%, and 98.8% for detecting depression, anxiety, and stress respectively — illustrating the precision attainable by well-trained classifiers applied to psychometric

data [15]. The application of similar architectures to psoriasis-specific datasets incorporating DLQI, PASI, inflammatory biomarkers, and psychiatric screening tools offers a realistic near-term clinical target.

Anxiety Disorders

Anxiety disorders affect approximately 21% of adults with psoriasis, with evidence of dose-response relationships between disease severity and anxiety burden [4]. The shared immunological pathways — particularly IL-17-mediated neuroinflammation — provide a mechanistic basis for this association, with AI-based molecular analyses adding important insights into biological vulnerability mechanisms [23, 24].

Liu and colleagues' 2024 study deciphering the genetic links between psychological stress, autophagy, and dermatological health using bioinformatics, single-cell analysis, and machine learning identified autophagy dysregulation as a potential molecular mediator of the psoriasis-anxiety comorbidity, with CASP7 emerging as a candidate therapeutic target [24]. Identifying patients with this molecular phenotype through AI-driven biomarker panels could facilitate earlier psychological intervention and personalised treatment selection.

Suicidal Ideation and Self-Harm

Suicidality in psoriasis represents perhaps the most clinically urgent psychiatric comorbidity, given its life-threatening implications. High-risk patient identification is currently dependent on clinician gestalt and time-constrained consultations — a model ill-suited to capturing the heterogeneous presentation of suicidal risk.

AI-powered suicide risk stratification models, validated in general psychiatric populations through NLP analysis of clinical notes, structured risk factor data, and patient-reported outcomes,



could be adapted for deployment in dermatology settings. Factors identified as predictors of suicidality in psoriasis — including severe disease, PsA comorbidity, social isolation, and depression — are amenable to algorithmic risk scoring [6, 22]. Mobile mental health applications capable of detecting linguistic markers of hopelessness and distress through conversational AI could provide an additional surveillance layer, particularly for patients who disengage from face-to-face care.

AI-Enabled Digital Health Technologies in Psoriasis Mental Health Care

Teledermatology and AI Integration

Teledermatology, accelerated significantly by the COVID-19 pandemic, has become an established modality for dermatological care delivery. The integration of AI into teledermatological workflows offers the prospect of automated disease severity assessment, treatment recommendation support, and — critically — embedded psychiatric screening [33, 36].

Virtual assistants validated in psoriasis populations have demonstrated feasibility for delivering well-being support, facilitating symptom tracking, and signposting mental health resources [34]. Chatbots incorporating CBT-based conversational scaffolding, mood tracking, and AI-driven risk detection represent the next generation of such tools — potentially deployable as adjuncts to specialist care rather than replacements for it.

Teledermatology platforms that have integrated AI in 2025 report improvements in workflow efficiency, administrative burden reduction, and patient satisfaction [36]. Generative AI has been deployed for automated patient intake, image organisation, and communication drafting — freeing clinician time that could be reinvested in psychiatric assessment and multidisciplinary care coordination.

Large Language Models and Generative AI

Large language models (LLMs), including ChatGPT and similar generative AI systems, have attracted increasing attention for potential deployment in mental health support roles. A 2025 assessment of generative AI-enabled digital mental health devices by the FDA's Digital Health Advisory Committee identified the potential of LLM-based conversational agents to close access gaps in mental health care — particularly for patient populations including psoriasis patients who may not present to mental health services despite significant psychiatric burden [37].

In dermatology specifically, LLMs are being evaluated for patient education, medication adherence support, and the generation of personalised management recommendations. Their application to psychiatric comorbidity management — including delivering psychoeducation about the psoriasis-depression relationship, facilitating completion of validated screening tools, and routing high-risk patients to appropriate services — represents a clinically plausible and practically feasible near-term application.

Wearable Technology and Continuous Monitoring

Wearable biosensors — measuring heart rate variability, sleep architecture, physical activity, and galvanic skin response — provide continuous physiological data streams that correlate with psychological state [35]. AI algorithms applied to wearable-derived data have demonstrated utility in predicting depression relapse and anxiety exacerbation in general mental health populations. Applied to psoriasis patients, wearable-based AI monitoring could provide early warning of psychiatric deterioration preceding clinical flare, enabling pre-emptive therapeutic adjustment and psychological support activation.



Summary of Key AI Studies in Psoriasis Psychiatric Comorbidities

Table 1 summarises the key AI studies reviewed, their methodologies, populations, and principal findings relevant to psychiatric comorbidities.

Author (Year)	AI Method	Population	Outcome	Key Finding
Flygare et al.	5 ML algorithms + scRNA-seq	GEO database (psoriasis + anxiety)	Biomarker identification	Identified 4 biomarkers linking psoriasis & anxiety; CASP7 implicated in T cell regulation
Liu et al. (2024)	Bioinformatics + ML + scRNA	GEO & bioinformatic datasets	Shared diagnostic genes	13 shared diagnostic genes identified between psoriasis and anxiety disorders; autophagy pathway implicated
Simmachan et al. (2025)	Random Forest, Penalised Regression	149 Thai psoriasis patients	DLQI prediction	Psychological stress outperformed PASI as DLQI predictor; integrated mental health screening advocated
Curtiss et al.	SVM with 10-fold CV	97 BDD patients (escitalopram)	Treatment outcome	AUC 0.77–0.79 for response/remission; lower DLQI and hopelessness predicted better outcomes
Emam et al.	GLM, SVM, DT, RF, GBT, DL	681 patients (DERMBIO registry)	Biologic response	GLM outperformed complex models; DLQI and PASI used as joint predictors of treatment failure
EHR-ML study (Israel)	SVM, RF, KNN, LR	Clalit EHR psoriasis cohort	Biologic therapy need	RF: AUC 0.93, recall 0.95; comorbid immune-mediated conditions key predictors
Branisteanu et al. (2025)	Cross-sectional + standardised tools	316 confirmed psoriasis patients	Psychiatric prevalence	27.8% had psychiatric comorbidity; substance use most common; integrated care recommended

Table 1. Summary of key AI studies relevant to psychiatric comorbidities in psoriasis. AI = Artificial Intelligence; ML = Machine Learning; SVM = Support Vector Machine; RF = Random Forest; DL = Deep Learning; GLM = Generalised Linear Model; DLQI = Dermatology Life Quality Index; GEO = Gene Expression Omnibus; BDD = Body Dysmorphic Disorder; EHR = Electronic Health Record; CV = Cross-Validation.

Challenges and Limitations

Data Quality and Standardisation

The primary constraint on AI model performance across all reviewed studies is data quality and standardisation. Clinical images captured without standardised protocols introduce lighting,

resolution, and framing artefacts that degrade CNN performance; psychometric data collected with inconsistent instruments across studies impede meta-analytic pooling; and psychiatric diagnoses embedded within EHRs are subject to coding inaccuracies and phenotypic heterogeneity [10, 11].



The small sample sizes characterising many psychodermatology datasets — driven by the relatively lower prevalence of severe psychiatric comorbidities and the resource-intensive nature of prospective data collection — limit model generalisability and statistical power. The study by Simmachan and colleagues, while methodologically rigorous, acknowledged that its Thai dataset of 149 patients may not generalise to broader populations [16, 28].

Algorithmic Bias and Skin Phototype Diversity

AI dermatology models have disproportionately been trained on datasets enriched for lighter Fitzpatrick skin phototypes, raising concerns about diagnostic equity in patients with darker skin [11]. This limitation extends to psychiatric risk prediction models that incorporate clinical imaging data. Future model development must explicitly incorporate diverse skin type representation, and validation studies must report performance metrics stratified by phototype, ethnicity, and geographic region [11].

Integration and Clinical Translation

Even well-validated AI models face significant barriers to clinical integration. Dermatologists and psychiatrists may lack the digital literacy to interpret AI-generated risk stratifications; institutional infrastructure for model deployment may be absent; and clinical governance frameworks for AI-assisted diagnosis remain nascent in many healthcare systems [9, 10].

The EU AI Act, which entered into force in 2024, classifies AI systems used as medical devices — including diagnostic and risk prediction tools — as high-risk, requiring third-party conformity assessment and stringent transparency obligations [40]. Regulatory compliance adds development burden but also provides a framework for ensuring safe, reliable AI deployment in clinical settings.

Ethical Considerations

The application of AI to psychiatric comorbidity in psoriasis raises important ethical questions including patient privacy, data security, algorithmic accountability, and the potential for discriminatory outputs. Patients with psychiatric conditions represent a vulnerable population, and AI-generated predictions of depression or suicidality carry significant consequences if erroneous [9, 10]. Explainable AI (XAI) frameworks — which generate interpretable rationale for algorithmic outputs — are essential prerequisites for responsible clinical deployment, enabling clinicians to audit, challenge, and contextualise AI recommendations rather than uncritically accepting them.

FUTURE DIRECTIONS

The trajectory of AI in the psoriasis-psychiatry domain points towards several compelling research and clinical priorities:

1. Large-scale prospective multicentre studies integrating clinical imaging, EHR data, validated psychiatric instruments, and molecular biomarkers are needed to train and validate robust, generalisable AI prediction models for psychiatric comorbidity in psoriasis.
2. Multimodal AI architectures that fuse dermatological imaging with psychometric questionnaire scores, inflammatory biomarker profiles, and wearable physiological data offer the greatest predictive power and most comprehensive phenotyping.
3. Federated learning approaches — enabling model training across distributed healthcare datasets without centralising sensitive patient data — can address data governance constraints while maximising dataset diversity.



4. Prospective evaluation of AI-powered screening tools for depression and anxiety within real-world psoriasis clinic settings, with patient and clinician co-design to ensure acceptability and usability.
5. Development and validation of explainable AI decision support systems that provide clinicians with interpretable, actionable psychiatric risk stratifications integrated into existing dermatology clinic workflows.
6. Regulatory-ready AI development pathways, aligned with evolving FDA and EU AI Act frameworks, to ensure that AI-based psychiatric screening tools can be approved and deployed as clinical-grade medical devices.
7. Investigation of the impact of biologic therapies — particularly IL-17, IL-23, and TNF- α inhibitors — on AI-defined psychiatric outcome trajectories, leveraging real-world registry data to determine whether pharmacological reduction of systemic inflammation translates into measurable improvements in ML-predicted depression and anxiety risk scores.

CONCLUSION

Psychiatric comorbidities — encompassing depression, anxiety, suicidal ideation, and substance use disorders — constitute a major and frequently underrecognised dimension of the psoriasis disease burden. Their pathophysiological roots in shared neuroinflammatory mechanisms, their bidirectional relationship with skin disease activity, and their profound impact on quality of life render them central rather than peripheral to psoriasis management.

Artificial intelligence, applied across the full spectrum from molecular biomarker discovery to clinical risk stratification, quality-of-life prediction, and digital health monitoring, offers a transformative toolkit for integrating psychiatric

care into the psoriasis management paradigm. Key demonstrations of AI utility in this domain include the ML-based identification of shared psoriasis-anxiety biomarkers, Random Forest models positioning psychological stress as a primary QoL determinant, EHR-based SVM models achieving high predictive accuracy for disease progression, and validated psychodermatology prediction models for treatment outcomes.

Substantial challenges remain — particularly regarding data standardisation, algorithmic bias, clinical integration, and ethical governance — that must be systematically addressed before AI-based psychiatric assessment tools can achieve routine clinical deployment. However, the convergence of rapidly improving AI capabilities, expanding real-world clinical datasets, and growing recognition of the psoriasis-psychiatry nexus creates uniquely favourable conditions for meaningful progress.

The future of psoriasis care must be holistic, data-driven, and psychiatrically informed. Artificial intelligence, thoughtfully developed, rigorously validated, and ethically deployed, offers the means to make this aspiration a clinical reality.

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