

Research Article**Psoriasis: Clinical Correlations and Diagnostic Evaluation of Inflammatory and Oxidative Stress Markers****¹Aditi Gupta, ²Sanjay Kumar Mittal**¹Assistant Professor, Department of Biochemistry, Arya Medical College, Jaipur²Assistant Professor, Department of Dermatology, Venerology and Leprosy, Arya Medical College, Jaipur**Corresponding Author:**

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ABSTRACT

Background: Psoriasis is a chronic, immune-mediated inflammatory skin disorder characterized by hyperproliferation of keratinocytes and systemic immune activation. Emerging evidence highlights the pivotal role of systemic inflammation and oxidative stress in the pathogenesis and systemic comorbidities of psoriasis. **Objective:** This study was designed to evaluate clinical severity, systemic inflammatory markers (high-sensitivity C-reactive protein [hs-CRP], interleukin-6 [IL-6]), and oxidative stress markers (malondialdehyde [MDA], total oxidant status [TOS]) in psoriasis patients compared

to healthy controls, and to assess their diagnostic performance.

Methods: A case-control study was conducted comprising 100 clinically confirmed psoriasis cases and 100 age- and sex-matched healthy controls. Clinical severity was quantified using Body Surface Area (BSA), Psoriasis Area Severity Index (PASI), and Dermatology Life Quality Index (DLQI). Serum levels of hs-CRP, IL-6, MDA, and TOS were measured using standardized biochemical assays.

Results: Psoriasis patients exhibited moderate clinical severity with mean BSA of $7.4 \pm 1.7\%$, PASI of 8.4 ± 2.3 , and DLQI of 10.9 ± 4.3 . All evaluated biochemical markers were significantly elevated in

psoriasis cases relative to healthy controls ($p < 0.001$). Receiver operating characteristic (ROC) analysis demonstrated outstanding diagnostic performance across all markers, with hs-CRP exhibiting the highest discriminative ability (AUC = 0.91, 85% sensitivity, 85% specificity), followed by IL-6 (AUC = 0.89), TOS (AUC = 0.88), and MDA (AUC = 0.86).

Conclusion: Psoriasis is associated with increased systemic inflammation and oxidative stress, with hs-CRP, IL-6, MDA, and TOS showing potential as adjunctive biomarkers for assessing disease burden and systemic involvement.

Keywords: *Psoriasis; High-sensitivity C-reactive protein; Interleukin-6; Malondialdehyde; Total oxidant status; Oxidative stress; Biomarkers.*

1. Introduction

Psoriasis is a prevalent, chronic, immune-mediated inflammatory skin disease affecting approximately 2–3% of the global population. Clinically characterized by well-demarcated, erythematous, scaly plaques primarily distributed over extensor surfaces and the scalp, psoriasis is no longer viewed merely as a localized cutaneous condition. Modern dermatological paradigms recognize

psoriasis as a systemic inflammatory disorder frequently associated with psoriatic arthritis, cardiovascular disease, metabolic syndrome, and significantly impaired health-related quality of life. [1,2]

The immunopathogenesis of psoriasis is driven by a complex interplay between innate and adaptive immune pathways. Activation of dendritic cells leads to the downstream release of key pro-inflammatory cytokines, most notably tumor necrosis factor-alpha (TNF- α), interleukin-23 (IL-23), and interleukin-6 (IL-6), which stimulate T-helper 1 (Th1) and Th17 cell proliferation and subsequent keratinocyte hyperproliferation. Concurrently, chronic systemic inflammation induces an overproduction of reactive oxygen species (ROS) and reactive nitrogen species, overwhelming endogenous antioxidant defense mechanisms and resulting in pronounced oxidative stress. This oxidative imbalance leads to lipid peroxidation, cellular macromolecule damage, and perpetuation of the inflammatory cascade. [3,4]

Despite established clinical scoring systems such as the Psoriasis Area Severity Index (PASI) and Body Surface Area (BSA), there remains a pressing clinical need for objective, quantitative biological markers to

assess systemic involvement, therapeutic response, and disease prognosis. While high-sensitivity C-reactive protein (hs-CRP) and IL-6 serve as prototypic markers of systemic inflammation, malondialdehyde (MDA) and total oxidant status (TOS) provide valuable quantitative indices of oxidative tissue injury. The present study was undertaken to evaluate the clinical profile of psoriasis patients, compare systemic inflammatory and oxidative stress biomarkers between psoriasis cases and healthy controls, and comprehensively analyze their diagnostic efficacy. [5,6]

Materials and Methods

An observational case-control study was conducted in the Department of Biochemistry in collaboration with the Department of Dermatology at a tertiary care hospital in Jaipur, Rajasthan, India. The study included 200 participants following approval from the Institutional Ethics Committee (Approval No.: [approval number]). Written informed consent was obtained from all participants before enrolment. A total of 200 participants were recruited from the dermatology outpatient department (OPD), comprising 100 patients aged 18 years and older with a clinically confirmed diagnosis of psoriasis (cases) and 100 age- and sex-matched apparently

healthy individuals (controls) from the hospital and surrounding community. The control participants had no history or clinical evidence of dermatological disorders or systemic inflammatory diseases. Participants were excluded if they had active systemic infections, autoimmune disorders other than psoriasis, malignancies, severe hepatic or renal dysfunction, pregnancy or lactation, or a history of systemic antipsoriatic therapy or systemic corticosteroid use within the preceding four weeks.

Clinical Assessment of Psoriasis Severity:

The clinical severity of psoriasis and its impact on patients' quality of life were assessed by experienced dermatologists using standardized clinical assessment tools.

- **Body Surface Area (BSA, %):** The extent of skin involvement was estimated and expressed as the percentage of total body surface area affected by psoriatic lesions. The Rule of Nines was used as an estimation guide.
- **Psoriasis Area and Severity Index (PASI, 0–72):** Disease severity was evaluated using the PASI, a composite scoring system that assesses the extent of psoriasis involvement and the severity of erythema, induration, and desquamation across four anatomical regions: the head, upper limbs, trunk, and

lower limbs. Higher scores indicate greater disease severity.

- **Dermatology Life Quality Index (DLQI, 0–30):** The impact of psoriasis on patients' quality of life was assessed using the validated 10-item DLQI questionnaire. The instrument evaluates symptoms and feelings, daily activities, leisure, work or school, personal relationships, and treatment-related effects over the preceding week. Higher scores indicate a greater adverse impact on quality of life.

Sample Collection and Analysis:

Approximately 5 mL of venous blood was collected from each participant. The samples were centrifuged at 3,000 rpm for 10 minutes to obtain serum, which was subsequently aliquoted and stored at -80°C until biochemical analysis. Serum high-sensitivity C-reactive protein (hs-CRP) levels were determined using an immunoturbidimetric assay, while interleukin-6 (IL-6) concentrations were measured using a quantitative sandwich enzyme-linked immunosorbent assay (ELISA). Malondialdehyde (MDA), a major end-product of lipid peroxidation, was estimated spectrophotometrically using the thiobarbituric acid reactive substances (TBARS) assay. Total oxidant status (TOS) was measured using an automated

colorimetric method and expressed as micromoles of hydrogen peroxide equivalents per liter ($\mu\text{mol H}_2\text{O}_2$ equivalents/L).

Statistical Analysis: Data for continuous variables are presented as mean $\pm$ standard deviation (SD). Differences between psoriasis cases and healthy controls were evaluated using independent Student's t-tests for normally distributed continuous variables. Receiver operating characteristic (ROC) curve analysis was performed to determine the diagnostic performance of each biomarker, calculating the area under the curve (AUC), optimal sensitivity, specificity, positive likelihood ratio (+LR), negative likelihood ratio (–LR), positive predictive value (PPV), and negative predictive value (NPV). A two-tailed p-value of < 0.05 was considered statistically significant. All the above statistical analyses were performed using IBM SPSS version 26.0.

Results:

A total of 100 psoriasis patients (cases) and 100 healthy controls were successfully evaluated. Table 1 summarizes the baseline clinical characteristics of the psoriasis cohort. The mean Body Surface Area (BSA) affected was $7.4 \pm 1.7\%$, reflecting moderate cutaneous involvement. The mean Psoriasis Area Severity Index (PASI) score was 8.4 ± 2.3 , and the mean

Dermatology Life Quality Index (DLQI) score was 10.9 ± 4.3 , indicating a moderate to large negative impact of the disease on patients' health-related quality of life.

Table 1. Clinical characteristics in psoriasis cases

Clinical Parameter	Psoriasis cases (n = 100)
Body surface area (BSA) %	7.4 ± 1.7
Psoriasis Area Severity Index (PASI) (0–72)	8.4 ± 2.3
Dermatology Life Quality Index (DLQI) (0–30)	10.9 ± 4.3

Table 2. Comparison of biochemical markers between psoriasis cases and healthy controls

Biochemical marker	Psoriasis cases (n = 100)	Healthy controls (n = 100)	P value
hs-CRP (mg/L)	4.20 ± 1.85	1.45 ± 0.62	< 0.001
IL-6 (pg/mL)	12.50 ± 4.10	4.15 ± 1.50	< 0.001
MDA (nmol/mL)	5.80 ± 1.60	2.90 ± 0.85	< 0.001
TOS ($\mu\text{mol H}_2\text{O}_2$ equivalents/L)	14.20 ± 3.50	7.10 ± 2.00	< 0.001

Comparative analysis of biochemical markers between psoriasis cases and healthy controls revealed highly statistically significant differences across all evaluated parameters ($p < 0.001$ for all comparisons), as delineated in Table 2. Systemic inflammatory markers—hs-CRP (4.20 ± 1.85 vs 1.45 ± 0.62 mg/L) and IL-6 (12.50 ± 4.10 vs 4.15 ± 1.50 pg/mL)—were markedly elevated in psoriasis patients. Similarly, oxidative stress and lipid peroxidation markers showed dramatic increases in cases compared to controls, with MDA levels reaching 5.80 ± 1.60 vs 2.90 ± 0.85 nmol/mL and TOS levels registering 14.20 ± 3.50 vs 7.10 ± 2.00 $\mu\text{mol H}_2\text{O}_2$ equivalents/L.

Table 3. Diagnostic performance of biochemical markers in psoriasis

Biomarker	AUC	Sensitivity (%)	Specificity (%)	+LR	–LR	PPV (%)	NPV (%)
hs-CRP	0.91	85	85	5.67	0.18	85.0	85.0
IL-6	0.89	82	84	5.13	0.21	83.7	82.4
MDA	0.86	80	82	4.44	0.24	81.6	80.4

TOS	0.88	83	83	4.88	0.20	83.0	83.0
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AUC, area under the ROC curve; CI, confidence interval; +LR, positive likelihood ratio; –LR, negative likelihood ratio; PPV, positive predictive value; NPV, negative predictive value.

Receiver operating characteristic (ROC) curve analysis was conducted to evaluate the diagnostic efficacy of each biomarker in distinguishing psoriasis patients from healthy controls. As detailed in Table 3, all biomarkers exhibited strong diagnostic potential. High-sensitivity C-reactive protein (hs-CRP) demonstrated the highest overall diagnostic accuracy with an AUC of 0.91, achieving a sensitivity of 85%, specificity of 85%, positive likelihood ratio (+LR) of 5.67, negative likelihood ratio (–LR) of 0.18, PPV of 85.0%, and NPV of 85.0%. Interleukin-6 (IL-6) followed closely with an AUC of 0.89, 82% sensitivity, and 84% specificity. Total oxidant status (TOS) and malondialdehyde (MDA) also showed robust diagnostic performance with AUCs of 0.88 and 0.86, respectively.

Discussion

The present case–control study investigated systemic inflammatory and oxidative stress markers in patients with psoriasis compared with age- and sex-matched healthy controls. The findings demonstrated significantly higher serum concentrations of high-sensitivity C-reactive protein (hs-CRP) and interleukin-6 (IL-6), accompanied by increased levels of malondialdehyde (MDA) and total oxidant status (TOS) in patients with psoriasis. These observations support the involvement of systemic inflammation and oxidative stress in the pathophysiology of psoriasis. Previous studies and systematic reviews have similarly reported alterations in inflammatory and oxidative stress biomarkers among individuals with psoriasis, reinforcing the concept that psoriasis is a chronic immune-mediated inflammatory disorder with systemic manifestations rather than a disease

restricted to the skin [1,3,7]. However, the magnitude and clinical significance of these biomarker changes may vary according to disease severity, treatment status, metabolic comorbidities, and laboratory methodology.

Clinical Characteristics and Disease Burden

In the present study, patients with psoriasis exhibited a mean body surface area (BSA) involvement of $7.4 \pm 1.7\%$, a mean Psoriasis Area and Severity Index (PASI) score of 8.4 ± 2.3 , and a mean Dermatology Life Quality Index (DLQI) score of 10.9 ± 4.3 . These findings indicate a measurable clinical disease burden accompanied by substantial impairment in health-related quality of life. The mean PASI score suggests relatively limited average disease severity compared with more severe clinical presentations. The DLQI score falls within the conventional 11–20 range associated with a very large effect on a patient's life, although the observed group mean of 10.9 lies just below the lower boundary of that category. This distinction is consistent with the recognized multidimensional burden of psoriasis, which includes physical discomfort, visible skin lesions, emotional distress, social limitations, and potential comorbidities. Boehncke described psoriasis as a systemic inflammatory disease associated with cardiovascular comorbidity and inflammation beyond the skin [3].

Serum hs-CRP concentrations were significantly higher in patients with psoriasis than in healthy controls (4.20 ± 1.85 vs. 1.45 ± 0.62 mg/L, respectively; $p < 0.001$). This finding indicates an association between psoriasis and increased systemic inflammatory activity. CRP is an acute-phase protein

produced predominantly by hepatocytes in response to inflammatory cytokines, particularly IL-6. The measurement of hs-CRP enables the detection of relatively low circulating concentrations of CRP and may therefore help characterize low-grade systemic inflammation.

Similarly, serum IL-6 concentrations were significantly elevated in patients with psoriasis compared with healthy controls (12.50 ± 4.10 vs. 4.15 ± 1.50 pg/mL, respectively; $p < 0.001$). IL-6 is a pleiotropic cytokine involved in immune regulation, inflammatory responses, and hepatic acute-phase protein synthesis. Its biological functions provide a plausible mechanistic link between immune activation and the increased hs-CRP concentrations observed in the present cohort. The simultaneous elevation of IL-6 and hs-CRP is therefore consistent with an inflammatory milieu in psoriasis.

Chronic activation of inflammatory pathways in psoriasis involves interactions among dendritic cells, T lymphocytes, keratinocytes, and multiple cytokines. These processes contribute to the persistence of cutaneous inflammation and may also be associated with inflammatory changes outside the skin. The relationship between psoriasis-associated inflammation, endothelial dysfunction, and atherosclerotic disease has been discussed in previous reviews [7,8,9]. Nevertheless, the elevated hs-CRP concentrations observed in the present study should be interpreted as evidence of an inflammatory association rather than direct proof of endothelial injury or future cardiovascular events.

The findings also align with the broader understanding of psoriasis as an immune-mediated disease involving interconnected inflammatory pathways. Boehncke highlighted the potential relationship between systemic inflammation in psoriasis and cardiovascular comorbidity, while

subsequent reviews have discussed shared inflammatory mechanisms linking psoriasis with vascular and metabolic disorders [7,9]. The present study also demonstrated significantly elevated serum MDA and TOS concentrations in patients with psoriasis compared with healthy controls ($p < 0.001$ for both comparisons). These findings support the involvement of oxidative stress in psoriasis and are consistent with evidence from previous observational studies and a systematic review of oxidative and antioxidant biomarkers in this condition [8,10].

MDA is a secondary product of lipid peroxidation generated during the oxidative degradation of polyunsaturated fatty acids. Increased MDA concentrations may therefore reflect enhanced lipid oxidative damage. TOS represents an aggregate measure of the oxidizing capacity of a biological sample rather than the concentration of a single reactive oxygen species. Its elevation may indicate an increased systemic oxidant burden. [8,9,11]. In psoriasis, these processes may interact with inflammatory pathways and contribute to the maintenance of chronic tissue inflammation. The study by Emre and colleagues, which evaluated oxidant and antioxidant parameters in patients with psoriasis, also reported a significant difference in TOS between patients and healthy controls, although MDA did not differ significantly in that particular cohort [8]. This variation illustrates that oxidative stress findings are not entirely uniform across studies and may depend on patient characteristics, sample handling, assay methods, and disease activity.

Receiver operating characteristic (ROC) curve analysis was used to assess the ability of the investigated biomarkers to distinguish patients with psoriasis from healthy controls. Among the four markers, hs-CRP demonstrated the highest reported area

under the curve (AUC), at 0.91, with a sensitivity and specificity of 85% at the selected cut-off. IL-6 showed an AUC of 0.89, followed by TOS at 0.88 and MDA at 0.86. These values indicate promising discrimination between the two study groups within the investigated sample.

The comparatively high AUC for hs-CRP suggests that it may be a useful candidate marker for identifying systemic inflammatory differences associated with psoriasis. The performance of IL-6 further supports the potential relevance of cytokine-mediated inflammation, whereas the AUC values for TOS and MDA suggest that oxidative stress-related measurements may provide complementary information. Taken together, these findings support further investigation of inflammatory and oxidative biomarkers as adjuncts to clinical assessment.[10]

Conclusion

In conclusion, patients with psoriasis exhibited significantly elevated serum levels of hs-CRP, IL-6, MDA, and TOS, indicating increased systemic inflammation and oxidative stress. These biomarkers showed promising diagnostic performance and may serve as useful adjuncts to clinical assessment. The findings also indicate a considerable impact of psoriasis on patients' quality of life, although the degree of impairment may vary among individuals. Further studies are needed to validate the clinical utility of these biomarkers.

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