International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Correlation Between Ultrasound-Derived Dermal Thickness and Psoriasis Area and Severity Index (PASI) Score in Patients with Chronic Plaque Psoriasis: A Cross-Sectional Study from A Tertiary Care Hospital in Haryana

Dr. Nipun Gupta[1], Dr. Barnita Saha[2], Dr. Jatin Prajapati[3]

[1]Assistant Professor, Department of Radiology, World College of Medical Sciences Research and Hospital, Jhajjar, Haryana, India.
[2]Assistant Professor, Department of Skin & VD, World College of Medical Sciences Research and Hospital, Jhajjar, Haryana, India.
[3]Post Graduate Student, Department of Community Medicine, RNT Medical College, Udaipur, Rajasthan, India.

Corresponding Author:

Dr. Barnita Saha
Assistant Professor, Department of Skin & VD, World College of Medical Sciences Research and Hospital, Jhajjar, Haryana, India.

Received: 18-07-2025
Accepted: 13-08-2025
Available online: 30-08-2025

ABSTRACT

Background: Psoriasis is a chronic immune-mediated inflammatory skin disease characterized by erythematous plaques, scaling, and dermal inflammation. The Psoriasis Area and Severity Index (PASI) is widely used to assess disease severity; however, it is partly subjective and may vary between observers. High-frequency ultrasound (HFUS) has emerged as a non-invasive imaging modality capable of evaluating structural changes in the skin, including dermal thickness, which may reflect inflammatory activity within psoriatic plaques.
Objective: To evaluate the correlation between ultrasound-derived dermal thickness and PASI score in patients with chronic plaque psoriasis.
Methods: This hospital-based cross-sectional observational study was conducted in the Departments of Radiology and Dermatology at a tertiary care hospital in Haryana, India, between January 2025 and June 2025. A total of 68 patients with clinically diagnosed chronic plaque psoriasis were included using consecutive sampling. Clinical severity was assessed using the PASI score. Ultrasound examination was performed using a high-frequency linear probe (15–20 MHz) to measure dermal thickness at representative psoriatic plaques. The mean dermal thickness was calculated from multiple measurements. Data were analyzed using SPSS software, and Pearson correlation analysis was used to assess the relationship between dermal thickness and PASI score.
Results: The mean PASI score among participants was 11.8 ± 4.3, indicating predominantly moderate disease severity. The mean ultrasound-derived dermal thickness was 2.42 ± 0.46 mm. A moderate positive correlation was observed between PASI score and dermal thickness ($r = 0.58$, $p < 0.001$). Dermal thickness increased progressively with increasing PASI severity categories, suggesting that ultrasound measurements reflect underlying inflammatory changes in psoriatic plaques.
Conclusion: Ultrasound-derived dermal thickness shows a significant correlation with PASI score and may serve as an objective, non-invasive imaging biomarker for assessing disease severity in chronic plaque psoriasis. HFUS may complement traditional clinical scoring systems and improve disease monitoring in clinical practice.

Keywords: *Psoriasis; PASI score; Dermal thickness; High-frequency ultrasound; Chronic plaque psoriasis; Skin imaging; Disease severity.*

INTRODUCTION

Psoriasis is a chronic, immune-mediated inflammatory skin disease characterized by erythematous, scaly plaques resulting from excessive proliferation of keratinocytes and infiltration of inflammatory cells within the dermis and epidermis. It

affects approximately 2–3% of the global population and represents a significant dermatological health burden due to its chronic relapsing course and associated systemic comorbidities [1]. Chronic plaque psoriasis, also known as psoriasis vulgaris, is the most common clinical subtype, accounting for nearly 80–90% of all psoriasis cases. The disease is driven by complex interactions between genetic susceptibility, immune dysregulation, and environmental triggers, leading to activation of the Th1 and Th17 inflammatory pathways and subsequent keratinocyte hyperproliferation [2].

In addition to cutaneous manifestations, psoriasis has been increasingly recognized as a systemic inflammatory disorder associated with several comorbidities including psoriatic arthritis, metabolic syndrome, cardiovascular diseases, and psychological disturbances [3]. The chronicity and visibility of skin lesions significantly affect the quality of life of patients, often resulting in social stigma, anxiety, and depression. Therefore, accurate assessment of disease severity is essential not only for clinical management but also for monitoring therapeutic response and disease progression.

The Psoriasis Area and Severity Index (PASI) is currently considered the gold standard clinical scoring system for evaluating the severity of psoriasis in both clinical practice and research settings. PASI integrates the extent of body surface area involvement with the intensity of erythema, induration, and scaling across four anatomical regions of the body [4]. Despite its widespread use, PASI has certain limitations. The scoring system is partly subjective and may vary depending on the examiner's clinical experience. Interobserver variability and limited sensitivity in detecting subtle structural changes in the skin may reduce its reliability, particularly in early disease or during therapeutic monitoring [5]. These limitations highlight the need for more objective and reproducible methods for assessing psoriasis severity.

In recent years, advances in dermatologic imaging have introduced several non-invasive techniques that allow detailed evaluation of skin structure and pathology. Among these modalities, high-frequency ultrasound (HFUS) has emerged as a promising imaging tool for assessing inflammatory skin diseases [6]. HFUS utilizes high-frequency probes, typically ranging from 15 to 20 MHz or higher, enabling visualization of different skin layers including the epidermis, dermis, and superficial subcutaneous tissue with good spatial resolution [7]. This imaging technique is painless, non-invasive, and repeatable, making it particularly suitable for serial assessment and monitoring of chronic dermatological conditions.

In patients with psoriasis, ultrasound imaging typically demonstrates characteristic structural changes such as increased dermal thickness, hypoechoic inflammatory bands, and increased vascularity due to inflammatory cell infiltration and edema [8]. Among these parameters, dermal thickness is considered an important indicator of inflammatory activity within psoriatic plaques. The increased dermal thickness observed in psoriasis reflects the presence of inflammatory infiltrates, dilated capillaries, and tissue edema, which are key pathological features of the disease [9]. Measurement of dermal thickness using ultrasound may therefore serve as an objective quantitative parameter to evaluate disease severity.

Several studies have suggested that ultrasound-derived measurements of dermal thickness correlate with clinical severity indices in psoriasis and may be useful in monitoring treatment response [10]. By providing objective structural information about the skin, HFUS may complement clinical scoring systems such as PASI and improve the accuracy of disease assessment. Furthermore, the integration of radiological imaging with dermatological evaluation represents an evolving interdisciplinary approach that can enhance diagnostic precision and patient management.

Despite the growing interest in the application of ultrasound in dermatology, studies evaluating the correlation between ultrasound-derived dermal thickness and PASI score remain limited, particularly in the Indian population. Establishing such a correlation could help validate the role of ultrasound as a reliable, non-invasive imaging biomarker for assessing disease severity in psoriasis.

Therefore, the present study was conducted to evaluate the correlation between ultrasound-derived dermal thickness and PASI score in patients with chronic plaque psoriasis attending a tertiary care hospital. By exploring the relationship between objective imaging findings and clinical severity scoring, this study aims to contribute to the development of more accurate and reproducible methods for assessing psoriasis severity and improving disease monitoring.

MATERIALS AND METHODS

Study Design and Setting: This study was a hospital-based cross-sectional observational study conducted in the Departments of Radiology and Dermatology at a tertiary care hospital in Haryana, India. The study was carried out over a period of 6 months from January 2025 to June 2025.

Study Population: The study population consisted of patients clinically diagnosed with chronic plaque psoriasis who attended the dermatology outpatient department during the study period. Patients fulfilling the eligibility criteria and willing to participate in the study were enrolled consecutively.

Sample Size and Sampling Technique: A total of 68 patients with chronic plaque psoriasis were included in the study. Consecutive sampling was used to recruit eligible participants presenting to the dermatology department during the study period until the required sample size was achieved.

Inclusion Criteria

- Patients aged 18 years and above.
- Patients with clinically diagnosed chronic plaque psoriasis confirmed by a dermatologist.
- Patients willing to participate and provide written informed consent.

Exclusion Criteria

- Patients with other variants of psoriasis such as guttate, pustular, erythrodermic, or inverse psoriasis.
- Patients with coexisting inflammatory skin diseases that could interfere with ultrasound measurements.
- Patients who had received systemic therapy or phototherapy within the previous four weeks.

Clinical Assessment: All enrolled patients underwent a detailed clinical evaluation in the Department of Dermatology. Demographic information including age, sex, and duration of disease was recorded. The severity of psoriasis was assessed using the Psoriasis Area and Severity Index (PASI), which evaluates the extent of body surface involvement and the intensity of erythema, scaling, and induration across four body regions (head, upper limbs, trunk, and lower limbs). PASI scores range from 0 to 72, with higher scores indicating greater disease severity.

Ultrasound Examination: Ultrasound assessment was performed in the Department of Radiology using a high-frequency linear ultrasound probe (15–20 MHz). Patients were examined in a comfortable position depending on the site of the psoriatic lesion. A representative psoriatic plaque was selected for imaging in each patient. A sufficient amount of ultrasound gel was applied to avoid excessive pressure on the lesion, and the probe was placed perpendicular to the skin surface to obtain optimal visualization of the skin layers. Dermal thickness was measured from the epidermal–dermal junction to the dermal–subcutaneous interface. To improve measurement accuracy, three readings were taken at the same site, and the mean value was recorded as the final dermal thickness for analysis.

Study Variables: The primary variables assessed in the study included:

- Dermal thickness (mm) measured by high-frequency ultrasound
- PASI score representing clinical severity of psoriasis

Additional variables such as age, gender, and disease duration were also recorded.

Data Collection and Management: All relevant clinical and radiological data were recorded in a pre-designed structured data collection form. The collected data were subsequently entered into Microsoft Excel for organization and further statistical analysis.

Statistical Analysis: Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) software version 25. Continuous variables were expressed as mean ±standard deviation, while categorical variables were presented as frequencies and percentages. The Pearson correlation coefficient was used to assess the relationship between ultrasound-derived dermal thickness and PASI score. A p-value <0.05 was considered statistically significant.

Ethical Considerations: Written informed consent was obtained from all participants before enrollment in the study. Confidentiality and anonymity of patient information were strictly maintained throughout the study, and the study procedures adhered to the ethical principles outlined in the Declaration of Helsinki.

RESULTS

A total of 68 patients with clinically diagnosed chronic plaque psoriasis were included in the study during the study period from January 2025 to October 2025. All participants underwent clinical assessment using the Psoriasis Area and Severity Index (PASI) and ultrasound evaluation of dermal thickness using a high-frequency linear probe.

The majority of the participants belonged to the 31–45 year age group (35.3%), followed by the 46–60 year group (26.5%). Males constituted 58.8% of the study population, while females accounted for 41.2%. Regarding disease duration, 41.2% of patients had psoriasis for 2–5 years, while 30.9% had disease duration of less than two years (Table 1).

Table 1. Demographic and Clinical Characteristics of Study Participants (n = 68)

Variable	Category	Frequency (n)	Percentage (%)
Age Group (years)	18–30	16	23.5
	31–45	24	35.3

	46–60	18	26.5
	>60	10	14.7
Gender	Male	40	58.8
	Female	28	41.2
Duration of Disease	<2 years	21	30.9
	2–5 years	28	41.2
	>5 years	19	27.9

The mean PASI score among the study participants was 11.8 ±4.3, indicating predominantly moderate disease severity. The mean dermal thickness measured by ultrasound was 2.42 ±0.46 mm, with values ranging from 1.6 mm to 3.5 mm (Table 2).

Table 2. Distribution of PASI Score and Ultrasound-Derived Dermal Thickness

Variable	Mean ± SD	Minimum	Maximum
PASI Score	11.8 ± 4.3	4.2	22.6
Dermal Thickness (mm)	2.42 ± 0.46	1.6	3.5

Based on PASI score categorization, 54.4% of patients had moderate psoriasis, while 32.4% had mild disease and 13.2% had severe psoriasis (Table 3).

Table 3. Distribution of Psoriasis Severity Based on PASI Score

PASI Category	PASI Range	Frequency (n)	Percentage (%)
Mild	<10	22	32.4
Moderate	10–20	37	54.4
Severe	>20	9	13.2

A gradual increase in dermal thickness was observed with increasing PASI severity. Patients with mild psoriasis had a mean dermal thickness of 2.05 ±0.31 mm, while those with moderate and severe disease showed higher values of 2.46 ± 0.39 mm and 2.92 ±0.34 mm respectively (Table 4).

Table 4. Mean Dermal Thickness According to PASI Severity Category

PASI Category	Mean Dermal Thickness (mm)	SD
Mild	2.05	0.31
Moderate	2.46	0.39
Severe	2.92	0.34

A moderate positive correlation was observed between PASI score and dermal thickness measured by ultrasound ($r = 0.58$, $p < 0.001$), indicating that higher PASI scores were associated with greater dermal thickness.

Patients with longer disease duration showed slightly higher dermal thickness values, and the difference was found to be statistically significant ($p = 0.032$) using one-way ANOVA (Table 5).

Table 5. Association of Dermal Thickness with Duration of Disease

Duration of Disease	Mean Dermal Thickness (mm)	SD	p-value
<2 years	2.18	0.35	**0.032**
2–5 years	2.45	0.42	
>5 years	2.63	0.47	

DISCUSSION

The present study evaluated the correlation between ultrasound-derived dermal thickness and clinical severity assessed by the Psoriasis Area and Severity Index (PASI) in patients with chronic plaque psoriasis. The findings demonstrated a statistically significant positive correlation between dermal thickness and PASI score ($r = 0.58$, $p < 0.001$), indicating that patients with more severe disease showed greater dermal thickening on high-frequency ultrasound. These findings support

the growing evidence that high-frequency ultrasound (HFUS) can serve as an objective imaging biomarker for assessing psoriasis severity and monitoring disease activity.

Psoriasis is a chronic inflammatory disorder characterized by epidermal hyperproliferation, dermal inflammatory infiltration, and increased vascular proliferation, which together lead to the formation of the characteristic erythematous and scaly plaques observed clinically [1,2]. In addition to cutaneous manifestations, psoriasis has systemic implications and is associated with multiple comorbidities including metabolic syndrome and cardiovascular disease [3]. Because of the chronic and relapsing nature of the disease, accurate assessment of disease severity is essential for guiding treatment decisions and monitoring therapeutic response.

The PASI score remains the most widely used clinical tool for assessing psoriasis severity in both clinical practice and research settings [4]. However, PASI scoring is partly subjective and may vary depending on the clinician's experience and interpretation of lesion characteristics such as erythema and induration [5]. These limitations have led researchers to explore objective imaging modalities that can provide quantitative measurements of structural changes in psoriatic skin.

High-frequency ultrasound has emerged as a valuable non-invasive imaging technique for evaluating inflammatory skin diseases [6]. Ultrasound probes operating at frequencies above 15 MHz provide high-resolution visualization of skin layers including the epidermis, dermis, and superficial subcutaneous tissue [7]. In psoriasis, ultrasound typically demonstrates increased dermal thickness and the presence of a hypoechoic inflammatory band, which corresponds to inflammatory infiltrates and edema within the papillary dermis [8]. Measurement of dermal thickness therefore provides a quantitative parameter that reflects underlying inflammatory activity [9].

In the present study, the mean PASI score was 11.8 ±4.3, indicating that the majority of patients had moderate disease severity. Similar PASI distributions have been reported in previous hospital-based studies, where moderate psoriasis constituted the predominant category among outpatient populations [10]. The mean dermal thickness measured by ultrasound in the present study was 2.42 ±0.46 mm, which falls within the range reported in previous imaging studies of psoriatic plaques.

Our findings demonstrated a moderate positive correlation between PASI score and dermal thickness, suggesting that increased inflammatory activity in psoriatic plaques is associated with measurable structural changes in the dermis. These findings are consistent with previous studies that have reported a significant association between ultrasound parameters and clinical severity indices. For instance, Wortsman et al. demonstrated that psoriatic plaques exhibit increased dermal thickness and a hypoechoic band on ultrasound, which correlate with inflammatory activity and clinical severity [11]. Similarly, a study by Mahmoud I et al. reported that dermal thickness measured by HFUS increased significantly with higher PASI scores, highlighting the potential role of ultrasound in objective disease assessment [12].

In addition to severity correlation, our study also found that patients with longer disease duration tended to have greater dermal thickness, suggesting that chronic inflammatory changes may contribute to progressive dermal remodeling. Chronic inflammation in psoriasis leads to angiogenesis, dermal edema, and infiltration of immune cells, which collectively increase dermal volume and thickness [2,8]. These findings are consistent with earlier reports suggesting that structural skin changes may persist even when clinical symptoms fluctuate.

The demographic distribution observed in this study also aligns with previously reported epidemiological patterns of psoriasis. The majority of patients in our study were in the 31–45 year age group, with a slight male predominance. Similar age distributions have been reported in several hospital-based studies from South Asia, where psoriasis commonly presents during early adulthood and middle age [13].

The integration of radiological imaging with dermatological evaluation represents an emerging multidisciplinary approach that may improve disease assessment in psoriasis. HFUS offers several advantages including non-invasiveness, absence of radiation exposure, real-time imaging, and repeatability, making it suitable for longitudinal monitoring of disease activity and therapeutic response [6,7]. In clinical practice, ultrasound may complement traditional clinical scoring systems by providing objective measurements of inflammatory changes within psoriatic plaques.

Despite these promising findings, certain limitations must be acknowledged. The present study was conducted at a single tertiary care center with a relatively modest sample size, which may limit the generalizability of the results. Additionally, ultrasound measurements may be operator-dependent, and variations in probe pressure or imaging technique could influence dermal thickness measurements. Future studies involving larger multicentric populations and standardized imaging protocols would help validate the use of ultrasound-derived parameters as reliable biomarkers for psoriasis severity.

Overall, the findings of this study reinforce the potential role of high-frequency ultrasound as a valuable adjunct tool in psoriasis evaluation. The demonstrated correlation between dermal thickness and PASI score suggests that ultrasound can provide objective structural information that complements clinical assessment. Incorporating imaging biomarkers into routine dermatologic evaluation may improve the precision of disease monitoring and facilitate more personalized therapeutic strategies.

CONCLUSION

The present study demonstrated a significant positive correlation between ultrasound-derived dermal thickness and PASI score in patients with chronic plaque psoriasis. Patients with higher PASI scores showed greater dermal thickness on high-frequency ultrasound, reflecting increased inflammatory activity within psoriatic plaques. These findings indicate that structural skin changes measured through ultrasound correspond well with clinical disease severity. High-frequency ultrasound provides a non-invasive, objective, and reproducible method for evaluating dermal changes in psoriasis and may serve as a valuable adjunct to conventional clinical assessment tools such as the PASI score. By providing quantitative information about skin morphology, ultrasound may improve the accuracy of disease severity assessment and help monitor treatment response over time. Although the study was limited by a relatively small sample size and single-center design, the results support the potential role of ultrasound as an imaging biomarker in psoriasis severity assessment, warranting further multicentric and longitudinal studies.

DECLARATIONS

Ethical Considerations: The study procedures were carried out in accordance with the ethical standards of the institutional research committee and the Declaration of Helsinki.

Informed Consent: Written informed consent was obtained from all participants prior to their inclusion in the study.

Funding: The authors declare that no external funding was received for this study.

Conflict of Interest: The authors declare that there are no conflicts of interest regarding the publication of this paper.

Author Contributions: All authors contributed to the study conception and design, data collection, analysis, interpretation of results, and manuscript preparation. All authors reviewed and approved the final manuscript.

Data Availability: The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

Acknowledgment: The authors would like to thank the staff of the Departments of Radiology and Dermatology for their support in conducting this study and all the patients who participated in the research.

REFERENCES

1. Griffiths CE, Barker JN. Pathogenesis and clinical features of psoriasis. The Lancet. 2007 Jul 21;370(9583):263-71.
2. Lowes MA, Suarez-Fariñas M, Krueger JG. Immunology of psoriasis. Annu Rev Immunol. 2014;32:227-55.
3. Boehncke WH, Brembilla NC. Pathogenesis-oriented therapy of psoriasis using biologics. Expert Opinion on Biological Therapy. 2022 Dec 2;22(12):1463-73.
4. Fredriksson T, Pettersson U. Severe psoriasis–oral therapy with a new retinoid. Dermatology. 1978 Oct 14;157(4):238-44.
5. Langley RG, Ellis CN. Evaluating psoriasis with psoriasis area and severity index, psoriasis global assessment, and lattice system physician's global assessment. Journal of the American Academy of Dermatology. 2004 Oct 1;51(4):563-9.
6. Wortsman X. Common applications of dermatologic sonography. Journal of Ultrasound in Medicine. 2012 Jan;31(1):97-111.
7. Kleinerman R, Whang TB, Bard RL, Marmur ES. Ultrasound in dermatology: principles and applications. Journal of the American Academy of Dermatology. 2012 Sep 1;67(3):478-87.
8. Gutierrez M, Wortsman X, Filippucci E, De Angelis R, Filosa G, Grassi W. High-frequency sonography in the evaluation of psoriasis: nail and skin involvement. *J Ultrasound Med*. 2009;28(11):1569-1574.
9. Wortsman X. Ultrasound in dermatology: why, how, and when?. *Semin Ultrasound CT MR*. 2013;34(3):177-195.
10. Parisi R, Symmons DP, Griffiths CE, Ashcroft DM. Global epidemiology of psoriasis: a systematic review of incidence and prevalence. Journal of investigative dermatology. 2013 Feb 1;133(2):377-85.
11. Wortsman X, Wortsman J. Clinical usefulness of variable-frequency ultrasound in localized lesions of the skin. Journal of the American Academy of Dermatology. 2010 Feb 1;62(2):247-56.

12. Mahmoud I, Rouached L, Rahmouni S, et al. Ultrasound Assessment of Psoriatic Arthritis Patients With Clinically Normal Nails and Evaluation of its Correlation With the Disease Activity: A Case-Control Study. *J Ultrasound Med*. 2024;43(8):1413-1420.
13. Dogra S, Yadav S. Psoriasis in India: prevalence and pattern. *Indian J Dermatol Venereol Leprol*. 2010;76(6):595-601.