





Hyperglycemia Is a Potential Prognostic Factor for Exacerbation in Severe Psoriasis with Diabetes or Prediabetes

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Background: Psoriasis is an immune-mediated skin disease with a chronic relapsing-remitting course. Hyperglycemia has been shown to correlate with psoriasis severity. However, whether it could trigger psoriasis flares is not known.

Objective: To investigate the association between hyperglycemia and psoriasis exacerbation.

Methods: We conducted a retrospective cohort study at a university-affiliated hospital in Bangkok, Thailand, between 2008 and 2022 to examine the effects of elevated HbA1c on psoriasis flares. Patients with psoriasis vulgaris and either type 2 diabetes mellitus (T2DM) or impaired fasting glucose (IFG) who had at least 2 HbA1c values were identified. Statistical analyses were performed using mixed-effects logistic regression.

Results: A total of 201 psoriasis patients (95 with severe psoriasis and 106 with mild psoriasis) with 1,717 follow-up visits were included in the analysis. In patients with severe psoriasis, HbA1c $\geq 7\%$ (adjusted odds ratio (OR): 1.905 (95% confidence interval: 1.328–2.731)) and alcohol consumption status (adjusted OR: 3.328 (1.235–8.965)) were identified as independent prognostic factors for psoriasis flares. Meanwhile, in mild psoriasis patients, none of the variables were independently associated with psoriasis flares.

Conclusion: Hyperglycemia and alcohol consumption were associated with exacerbation in patients with severe psoriasis who had T2DM/IFG.

Plain Language Summary: Certain environmental factors, such as infections and medications, can cause psoriasis flare-ups. Research suggests that psoriasis-induced inflammation can trigger insulin resistance and high blood sugar (hyperglycemia), which in turn triggers abnormal functioning of the blood vessel's inner lining, ultimately leading to atherosclerosis and cardiovascular disease. Interestingly, insulin resistance may also worsen psoriatic skin lesions. Multiple studies have found a correlation between psoriasis severity and hemoglobin A1C (HbA1c, average blood sugar levels for the last 3 months); however, it is unknown whether hyperglycemia can also cause psoriasis exacerbation. We aimed to explore the potential of hyperglycemia as a predictor of psoriasis flare-ups. Our study highlights the importance of managing diabetes and psoriasis concurrently to improve the health outcomes of psoriasis patients. Patients with severe psoriasis and diabetes or prediabetes with high blood sugar (HbA1c $\geq 7\%$) or a history of alcohol consumption are at higher risk of exacerbation. Diabetes monitoring is required for all psoriasis patients, and strict glycemic control may aid in the management of psoriasis.

Keywords: psoriasis, diabetes mellitus type 2, impaired fasting glucose, prognosis, exacerbation

Introduction

Psoriasis is a chronic immune-mediated skin disease that affects approximately 100 million people of all ages and genders worldwide, with prevalence rates ranging from <1% to 5%.^{1,2} Plaque psoriasis, the most prevalent variant, is

classically defined by erythematous scaly plaques that are frequently observed on extensor surfaces, as well as other body sites, such as the nail.³ The pathogenesis of psoriasis mainly involves the overactivation of the adaptive immune system, particularly the T-helper cell type 17 pathway.³ It is being recognized as a systemic inflammatory disease with associated disorders such as psoriatic arthritis, cardiometabolic diseases, chronic kidney disease, and hepatic diseases, leading to an increase in mortality, particularly in severe cases.^{1,4,5}

Hyperglycemia has a detrimental effect on our health in a variety of ways, including acute complications such as infection and diabetic coma, as well as chronic complications like cataract and myocardial infarction.⁶ Although it is still debatable whether or not psoriasis itself is a prediabetic condition,⁷ multiple studies have demonstrated that psoriasis is an independent risk factor for insulin resistance.^{8–10} Moreover, type 2 diabetes mellitus (T2DM) is significantly more prevalent in patients with psoriasis than in the general population,^{11–14} and large cohort studies have identified psoriasis as an independent risk factor for developing incident T2DM.^{15,16} Patients with psoriasis may therefore be predisposed to type 2 diabetes mellitus (T2DM).

Certain environmental factors, such as infections and medications, are capable of triggering psoriasis flare.¹⁷ According to the “psoriatic march” theory, psoriasis-induced systemic inflammation leads to insulin resistance, endothelial dysfunction, atherosclerosis, and cardiovascular disease.¹⁸ Interestingly, insulin resistance may also worsen psoriatic skin lesions.^{19,20} This is supported by the correlation between psoriasis severity and hemoglobin A1c (HbA1c), as well as insulin resistance,^{21–23} however, it is unknown whether hyperglycemia can also cause psoriasis exacerbation. Understanding the association between hyperglycemia and psoriasis exacerbation is crucial for optimizing treatment and patient education; therefore, we aimed to determine whether hyperglycemia predicts psoriasis flares.

Materials and Methods

Study Design and Ethical Consideration

A 15-year retrospective cohort study of patients with psoriasis and either T2DM or impaired fasting glucose (IFG) was conducted. The study was approved by the Institutional Review Boards of Mahidol University (COA. MURA2022/541) which are in full compliance with international guidelines for human research protection such as the Declaration of Helsinki.

Patient Selection Process

Data extraction was conducted between September 2022 and June 2024, reviewing medical records of all outpatients aged 18 years or over who were treated at Ramathibodi Hospital, Bangkok, Thailand, from January 1, 2008, to September 1, 2022, with an International Classification of Diseases, 10th Revision (ICD-10) code of L40.0 (psoriasis vulgaris) and either R73.0 (abnormal glucose tolerance test) or E11.9 (T2DM) were reviewed.

Eligible patients must have had a diagnosis of psoriasis vulgaris along with T2DM or IFG, with at least 2 HbA1c values that were matched with respective values of Psoriasis Area and Severity Index (PASI) or extent of psoriasis lesions in percentage of body surface area (BSA) recorded not later than 3 months after the HbA1c measurement. In addition, at least one of their HbA1c levels must have been at least 5.7%, as the cutoff value of 5.7% was used as the diagnostic threshold for prediabetes, and we intended to investigate the possible contribution of hyperglycemia to psoriasis exacerbation in psoriasis patients with prediabetes or diabetes.²⁴ Patients on immunosuppressants due to organ transplantation or with autoimmune comorbidities, such as systemic lupus erythematosus, were excluded from the study. Patients who were receiving chemotherapy or systemic corticosteroids were also excluded.

Definitions of Psoriasis Severity and Exacerbations

Patients with a maximum PASI of ≥ 10 or a maximum BSA of $\geq 10\%$ were classified as having severe psoriasis in our study, and those with a maximum PASI of < 10 and a maximum BSA of $< 10\%$ as having mild psoriasis. This classification was used throughout the data analysis. To ensure that the same psoriasis exacerbation criteria are used for all flare evaluations, two board-certified dermatologists (KT and PR) agreed upon exacerbation criteria that take into account the nature of flaring in mild and severe psoriasis, as well as dose escalations or initiation of systemic therapy. We

defined a psoriasis flare in severe psoriasis as any of the following: an increase in dosage of the current systemic medication(s), an initiation of a new systemic medication or phototherapy, or an increase in PASI of ≥ 3 or in psoriasis involvement of $\geq 3\%$ BSA from the previous visit. However, the usual dose escalation in the initial stage of treatment with methotrexate was not considered to be a flare. Meanwhile, any of the following was considered a mild psoriasis flare-up: an initiation of systemic therapy or phototherapy for psoriasis, or any increase in PASI or percentage of BSA affected by psoriasis from the previous visit.

Data Collection

The patient's demographics, medical comorbidities, clinical presentations, laboratory results, type and dosage of systemic therapy (methotrexate, cyclosporine, acitretin, phototherapy, and biologic agents), reasons for changing or increasing dosage of systemic therapy, PASI, and percentage of BSA affected by psoriasis were extracted from the medical records. HbA1c values from within 3 months prior to the physical examination were used, and the cutoff level of 7% for categorizing HbA1c was adopted from the treatment goals for diabetes management in the most recent guideline from the American Diabetes Association.²⁵

Statistical Analysis

Frequency and percentage were used to describe categorical data. For continuous data, the mean and standard deviation (SD) were used. All analyses were carried out separately in patients with mild and severe psoriasis, according to the above-mentioned classification. Univariate analysis was performed on all available variables using mixed-effects logistic regression models with psoriasis exacerbation as the outcome. The variables with p-values < 0.2 from the univariate analysis and those considered to be clinically relevant to psoriasis severity (ie, type and dosage of systemic therapy for psoriasis, body mass index (BMI), smoking status, and alcohol consumption status) were included in multivariate mixed-effects logistic regression models. P-values of < 0.05 were considered statistically significant. The Stata statistical software package version 16.0 (StataCorp, College Station, TX) was used in all analyses.

Results

There were 418 outpatients with ICD-10 codes of L40.0 with either R73.0 or E11.9. Two hundred and seven of them were excluded for the reasons shown in [Figure 1](#). The remaining 211 cases were reviewed further to eliminate cases that met the exclusion criteria, and 10 cases were dismissed. Finally, 201 psoriasis patients were eligible ([Figure 1](#)), with a median follow-up time of 4.67 years (range: 1.38 months to 11.25 years). They had a median number of visits of 6 (range: 2–41) and a total of 1717 visits. Of these, 95 patients, whose median number of visits was 7.5 (range: 2–41), were classified to have severe psoriasis. The other 106 patients had mild psoriasis, with a median number of visits of 5.5 (range: 2–25).

Overall, the mean (SD) age was 56.96 (12.71) years, and 118 (58.71%) of the patients were male, with a mean (SD) BMI of 28.14 (5.96) kg/m². One hundred thirty-one (65%) patients had T2DM, while the remaining (34.83%) had IFG. Other common comorbidities include dyslipidemia in 177 (88.06%) patients, essential hypertension in 143 (71.14%) patients, metabolic syndrome in 118 (58.71%) patients, nonalcoholic fatty liver disease in 48 (23.88%) patients, chronic kidney disease 23 (11.44%) patients, and cardiovascular disease in 34 (16.92%) patients. The patients' characteristics are summarized in [Table 1](#).

Exacerbation was found in a total of 523 (30.46%) visits from 149 (74.13%) psoriasis patients, comprising 295 (31.25%) visits from 74 (77.89%) patients with severe psoriasis and 228 (29.50%) visits from 75 (70.75%) patients with mild psoriasis.

The results of univariate and multivariate analysis of potential prognostic factors for exacerbation in patients with severe psoriasis are shown in [Table 2](#). Univariate analysis revealed HbA1c $\geq 7\%$ and alcohol consumption status to be associated with psoriasis flares in patients with severe psoriasis, with odds ratios (OR) of 1.753 (95% confidence interval: 1.218–2.524) and 2.848 (1.020–7.953), respectively. Multivariate analysis revealed that HbA1c $\geq 7\%$ and alcohol consumption status were factors independently associated with psoriasis flares in patients with severe psoriasis, with adjusted ORs of 1.905 (1.328–2.731) and 3.328 (1.235–8.965), respectively.

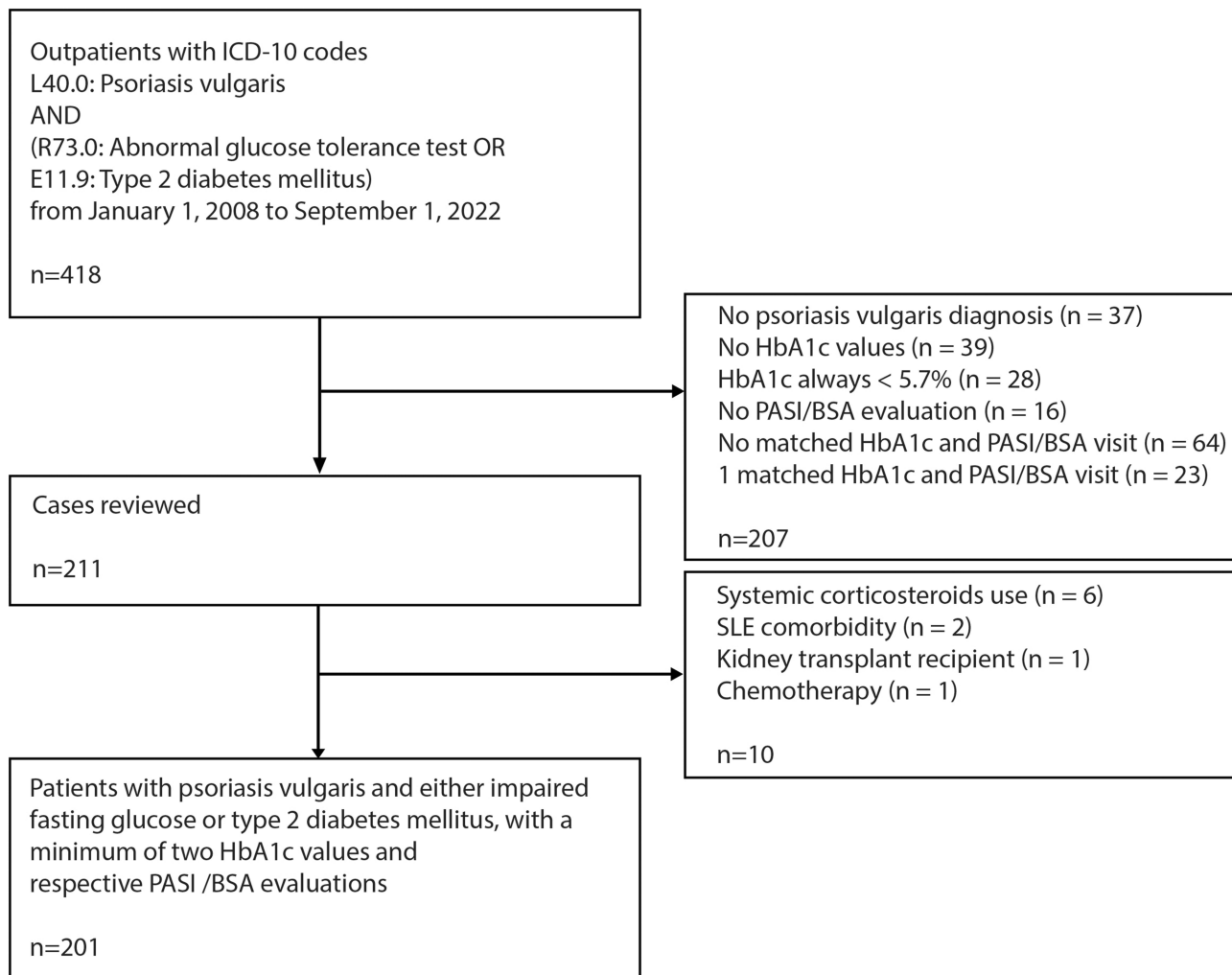


Figure 1 Flow diagram of the patient selection process.

From the univariate analysis in patients with mild psoriasis, HbA1c $\geq 7\%$ was associated with psoriasis flares with OR of 1.544 (1.068–2.232), while male gender, cardiovascular disease, and chronic kidney disease were found to be protective for psoriasis flares with ORs of 0.592 (0.385–0.910), 0.530 (0.315–0.892), and 0.478 (0.263–0.867),

Table 1 Patients’ Characteristics in Relation to Psoriasis Severity

Characteristics	Psoriasis Patients	Severe Psoriasis Patients	Mild Psoriasis Patients
Number of patients	201	95	106
Age, years; mean (SD)	56.96 (12.71)	55.92 (11.34)	57.89 (13.80)
Male; n (%)	118 (58.71)	55 (57.89)	63 (59.43)
BMI; mean (SD)	28.14 (5.96)	27.75 (5.82)	28.52 (6.11)
Smoking status; n (%)	9 (4.48)	6 (6.32)	3 (2.83)
Alcohol consumption status; n (%)	14 (6.97)	6 (6.32)	8 (7.55)

(Continued)

Table 1 (Continued).

Characteristics	Psoriasis Patients	Severe Psoriasis Patients	Mild Psoriasis Patients
Medical comorbidity; n (%)			
Psoriatic arthritis	51 (25.37)	35 (36.84)	16 (15.09)
Type 2 diabetes mellitus	131 (65.17)	59 (62.11)	72 (67.92)
Impaired fasting glucose	70 (34.83)	36 (37.89)	34 (32.08)
Essential hypertension	143 (71.14)	63 (66.32)	80 (75.47)
Dyslipidemia	177 (88.06)	83 (87.37)	94 (88.68)
Metabolic syndrome	118 (58.71)	52 (54.74)	66 (62.26)
NAFLD	48 (23.88)	32 (33.68)	16 (15.09)
Chronic kidney disease	23 (11.44)	7 (7.37)	16 (15.09)
Cardiovascular disease	34 (16.92)	9 (9.47)	25 (23.58)
Systemic treatment, n (%)			
Methotrexate	80 (39.80)	66 (69.47)	14 (13.21)
Cyclosporine	17 (8.46)	17 (17.89)	0
Acitretin	36 (17.91)	31 (32.63)	5 (4.72)
NB-UVB	40 (19.90)	34 (35.79)	6 (5.66)
PUVA	9 (4.48)	9 (9.47)	0
IL-17 inhibitors	16 (7.96)	16 (16.84)	0
IL-17/23 inhibitors	3 (1.49)	3 (3.16)	0
IL-23 inhibitors	1 (0.50)	1 (1.05)	0

Abbreviations: BMI, body mass index; NAFLD, non-alcoholic fatty liver disease; NB-UVB, narrowband ultraviolet B; PUVA, psoralen and ultraviolet A; SD, standard deviation.

Table 2 Univariate and Multivariate Analysis of Potential Prognostic Factors for Exacerbation in Patients With Severe Psoriasis

Factor	Univariate		Multivariate*	
	Odds Ratio (95% CI)	P-value	Odds Ratio (95% CI)	P-value
HbA1c \geq 7%	1.753 (1.218–2.524)	0.003 [†]	1.905 (1.328–2.731)	<0.001
Age, years	0.992 (0.979–1.005)	0.246		
Male	1.674 (0.979–2.863)	0.060 [†]	1.599 (0.976–2.620)	0.062
BMI, kg/m ²	1.028 (0.989–1.068)	0.163 [†]	1.013 (0.978–1.050)	0.456
Smoking status	0.613 (0.164–2.285)	0.466 [‡]	0.612 (0.171–2.191)	0.451
Alcohol consumption status	2.848 (1.020–7.953)	0.046 [†]	3.328 (1.235–8.965)	0.017
Psoriatic arthritis	0.891 (0.524–1.517)	0.671		
Essential hypertension	1.459 (0.832–2.558)	0.188 [†]	1.380 (0.832–2.289)	0.212
Dyslipidemia	1.089 (0.453–2.618)	0.850		
NAFLD	1.633 (0.976–2.732)	0.062 [†]	1.064 (0.659–1.718)	0.798
Cardiovascular disease	1.518 (0.676–3.411)	0.312		
Chronic kidney disease	0.626 (0.262–1.496)	0.292		

Notes: Variables with p-values <0.05 are indicated by the bold font. *Also adjusting for type and dosage of systemic therapy for psoriasis. [†]Variables with p-values <0.2 and subsequently used in the multivariate model selection. [‡]Variables with p-values ≥ 0.2 that were considered to be clinically relevant to psoriasis severity and were subsequently used in the multivariate model selection.

Abbreviations: CI, confidence interval; BMI, body mass index; HbA1c, hemoglobin A1c; NAFLD, non-alcoholic fatty liver disease.

Table 3 Univariate and Multivariate Analysis of Potential Prognostic Factors for Exacerbation in Patients With Mild Psoriasis

Mild Psoriasis Factor	Univariate		Multivariate	
	Odds Ratio (95% CI)	P-value	Odds Ratio (95% CI)	P-value
HbA1c \geq 7%	1.544 (1.068–2.232)	0.021 [†]	1.306 (0.908–1.877)	0.150
Age, years	0.994 (0.978–1.011)	0.520		
Male	0.592 (0.385–0.910)	0.017 [†]	0.659 (0.417–1.041)	0.074
BMI, kg/m ²	1.007 (0.968–1.047)	0.734 [‡]	0.999 (0.963–1.037)	0.973
Smoking status	1.155 (0.300–4.442)	0.834 [‡]	1.415 (0.408–4.905)	0.584
Alcohol consumption status	1.022 (0.453–2.307)	0.958	1.141 (0.555–2.345)	0.719
Psoriatic arthritis	1.632 (0.969–2.750)	0.066 [†]	1.351 (0.848–2.152)	0.205
Essential hypertension	1.234 (0.692–2.201)	0.477		
Dyslipidemia	0.901 (0.378–2.145)	0.813		
NAFLD	1.457 (0.827–2.566)	0.192 [†]	1.671 (0.987–2.829)	0.056
Cardiovascular disease	0.530 (0.315–0.892)	0.017 [†]	0.858 (0.506–1.453)	0.569
Chronic kidney disease	0.478 (0.263–0.867)	0.015 [†]	0.640 (0.361–1.133)	0.126

Notes: Variables with p-values <0.05 are indicated by the bold font. [†]Variables with p-values <0.2 and subsequently used in the multivariate model selection. [‡]Variables with p-values ≥ 0.2 that were considered to be clinically relevant to psoriasis severity and were subsequently used in the multivariate model selection.

Abbreviations: CI, confidence interval; BMI, body mass index; HbA1c, hemoglobin A1c; NAFLD, non-alcoholic fatty liver disease.

respectively. However, the multivariate analysis revealed that none of these factors were significantly associated with psoriasis flares. Table 3 shows the results of univariate and multivariate analysis of potential prognostic factors for exacerbation in patients with mild psoriasis.

Discussion

Our study was a 15-year retrospective cohort study aimed at investigating the association between hyperglycemia and psoriasis exacerbation. Previous studies have established that HbA1c and insulin resistance correlate with psoriasis severity.^{21–23} In our study, we found that HbA1c \geq 7% could be an independent prognostic factor for flare in patients with severe psoriasis, with an adjusted OR of 1.905. Our choice of HbA1c \geq 7% as a threshold was based on established diabetes treatment targets from the American Diabetes Association. This clinically relevant cutoff point allows our findings to be readily integrated into existing diabetes management protocols while providing new insights into psoriasis care.

Psoriasis patients with comorbidities such as diabetes appear to be more resistant to treatment.^{26–28} Insulin resistance may induce psoriasis exacerbation.^{19,20} We hypothesize that hyperglycemia in diabetic or prediabetic psoriasis patients may also increase their overall inflammatory burden²⁹ or interfere with the mechanisms of psoriatic medications, thereby reducing the likelihood of successful treatment. A number of studies have demonstrated that the presence of diabetes has an impact on the effectiveness of specific anti-psoriatic medications, particularly biologic agents. Diabetes was found to significantly reduce the odds of achieving PASI75 and PASI90 in psoriasis patients taking interleukin-17 inhibitors by 39% and 31%, respectively, after adjusting for other prognostic factors including obesity.³⁰ Psoriasis with coexisting diabetes have been found to have a reduced likelihood of experiencing a positive response to ustekinumab^{29,31,32} and secukinumab.²⁹ Higher HbA1c level was also identified as one of the predictors of secondary infliximab treatment failure.³³ Likewise, diabetes was found to significantly reduce the probability of achieving PASI75 and PASI50 in psoriasis patients taking methotrexate or cyclosporine.³⁴ In addition, acitretin can interfere with hypoglycemic agents and impair glycemic control in diabetic patients,^{35,36} and since hyperglycemia may exacerbate psoriasis, a suboptimal response to acitretin in psoriasis patients with T2DM or IFG may be anticipated. Therefore, diabetic and pre-diabetic psoriasis patients who are resistant to therapy may benefit from glucose monitoring. Patients who experience an acitretin-induced psoriatic flare in the initial weeks^{35,37} or exacerbations with no known precipitants may also benefit from glucose surveillance. The effects of hyperglycemia on psoriasis treatment response and its associated mechanisms require additional research.

Diabetes is one of the significant predictors for lack of improvement in the Dermatology Life Quality Index (DLQI) score of psoriasis patients.³⁸ Given that hyperglycemia may exacerbate psoriasis in diabetic or prediabetic psoriasis patients and that the presence of T2DM or IFG may be associated with a poorer response to medications, hyperglycemia control may contribute to psoriasis improvement and, accordingly, an improvement in quality of life. A recent meta-analysis revealed that psoriasis patients randomized to receive hypoglycemic medications exhibited a significant reduction in PASI score and an increased likelihood of achieving PASI75.³⁹ Managing hyperglycemia in psoriasis patients with diabetes may therefore reduce the likelihood of flares, lessen psoriasis severity, and improve treatment response. Consequently, in addition to treating psoriatic plaques, dermatologists and other healthcare professionals should also monitor diabetes management and surveillance in psoriasis patients, particularly those whose symptoms flare up or are resistant to treatment.

In mild psoriasis patients, however, after adjusting for various factors, hyperglycemia was not found to be associated with psoriasis flares with statistical significance in the present study. The dose-response relationship between diabetes, insulin resistance, and psoriasis has been shown in previous studies,^{15,16,21,40} and so the stronger association between hyperglycemia and psoriasis flares in severe psoriasis patients is not unexpected. Since insulin resistance may also result in endothelial dysfunction, atherosclerosis, and subsequent cardiovascular diseases¹⁸ in addition to its potential role in psoriasis flare-ups, we believe that diabetes screening and early lifestyle interventions are essential for all psoriasis patients, regardless of disease severity.

Psoriasis patients are more likely to become excessive drinkers than the general population.⁴¹ Alcohol drinking was found to correlate with psoriasis severity, a poorer response to psoriasis treatment, and increased alcohol-related mortality from causes such as alcoholic liver diseases, liver fibrosis, and mental disorders in psoriasis patients.^{41–44} In addition to diabetes, alcoholism is a significant predictor for absence of improvement in the DLQI score of psoriasis patients.³⁸ Our findings revealed that alcohol consumption status is one of the independent prognostic factors for psoriasis exacerbation in patients with severe psoriasis, with an adjusted OR of 3.328. In addition to increasing morbidity and mortality among psoriasis patients, alcohol also impacts the condition and treatment of the disease. Therefore, dermatologists and other healthcare professionals should strongly advise patients to abstain from alcohol consumption, and referral to specialists for specialized care may be necessary. Additionally, since lifestyle habits are closely linked to both glycemic control and alcohol abstinence, it is crucial for the entire healthcare system to adopt a person-centered approach.

Our research has a few limitations. A small sample was collected from a single university hospital. In addition, many records lacked information such as the degree of alcohol consumption and other details. We excluded from our analysis the history of exposure to known exacerbating factors, such as infection and drugs, because of the inherent reporting bias of the trigger questioning, which was conducted only during visits in which patients had a psoriasis flare. To confirm our findings, larger, multi-center, well-designed prospective studies are needed.

Conclusion

In our study, we found that hyperglycemia ($\text{HbA1c} \geq 7\%$) and alcohol drinking status were independent prognostic factors for exacerbation in severe psoriasis patients with diabetes or prediabetes. We believe that diabetes surveillance may be necessary for all psoriasis patients, and strict glycemic control may aid in managing severe psoriasis. Further research is required to confirm the impact of hyperglycemia on the severity and treatment of psoriasis.

Data Sharing Statement

The data sets used to support the findings of this study are available from the corresponding author upon request.

Ethics Approval and Consent to Participate

This retrospective cohort study was employed in a university-based hospital (Ramathibodi Hospital, Bangkok, Thailand). The Institutional Review Board for Ethics in Human Research approved this study following the principles of the Declaration of Helsinki (MURA2022/541). The need for informed consent was waived, and data were analyzed anonymously.

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Disclosure

The authors declare that this manuscript was prepared in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

References

1. World Health Organization. *Global Report on Psoriasis*. Geneva: World Health Organization; 2016.
2. Neimann AL, Porter SB, Gelfand JM. The epidemiology of psoriasis. *Exp Rev Dermatol*. 2006;1(1):63–75. doi:10.1586/17469872.1.1.63
3. Armstrong AW, Read C. Pathophysiology, clinical presentation, and treatment of psoriasis: a review. *JAMA*. 2020;323(19):1945–1960. doi:10.1001/jama.2020.4006
4. Gelfand JM, Troxel AB, Lewis JD, et al. The risk of mortality in patients with psoriasis: results from a population-based study. *Arch Dermatol*. 2007;143(12):1493–1499. doi:10.1001/archderm.143.12.1493
5. Yeung H, Takeshita J, Mehta NN, et al. Psoriasis severity and the prevalence of major medical comorbidity: a population-based study. *JAMA Dermatol*. 2013;149(10):1173–1179. doi:10.1001/jamadermatol.2013.5015
6. Kawahito S, Kitahata H, Oshita S. Problems associated with glucose toxicity: role of hyperglycemia-induced oxidative stress. *World J Gastroenterol*. 2009;15(33):4137–4142. doi:10.3748/wjg.15.4137
7. Friis NU, Hoffmann N, Gyldenløve M, et al. Glucose metabolism in patients with psoriasis. *Br J Dermatol*. 2019;180(2):264–271. doi:10.1111/bjd.17349
8. Karadag AS, Yavuz B, Ertugrul DT, et al. Is psoriasis a pre-atherosclerotic disease? Increased insulin resistance and impaired endothelial function in patients with psoriasis. *Int J Dermatol*. 2010;49(6):642–646. doi:10.1111/j.1365-4632.2009.04358.x
9. Okan G, Baki AM, Yorulmaz E, Doğru-Abbasoğlu S, Vural P. Serum Visfatin, Fetuin-A, and Pentraxin 3 levels in patients with psoriasis and their relation to disease severity. *J Clin Lab Anal*. 2016;30(4):284–289. doi:10.1002/jcla.21850
10. Albareda M, Ravella A, Castelló M, Saborit S, Peramiqnel L, Vila L. Metabolic syndrome and its components in patients with psoriasis. *Springerplus*. 2014;3:612. doi:10.1186/2193-1801-3-612
11. Parisi R, Rutter MK, Lunt M, et al. Psoriasis and the risk of major cardiovascular events: cohort study using the clinical practice research datalink. *J Invest Dermatol*. 2015;135(9):2189–2197. doi:10.1038/jid.2015.87
12. Bang CN, Okin PM, Køber L, Wachtell K, Gottlieb AB, Devereux RB. Psoriasis is associated with subsequent atrial fibrillation in hypertensive patients with left ventricular hypertrophy: the Losartan intervention for endpoint study. *J Hypertens*. 2014;32(3):667–672. doi:10.1097/HJH.0000000000000078
13. Sommer DM, Jenisch S, Suchan M, Christophers E, Weichenthal M. Increased prevalence of the metabolic syndrome in patients with moderate to severe psoriasis. *Arch Dermatol Res*. 2006;298(7):321–328. doi:10.1007/s00403-006-0703-z
14. Buja A, Miatton A, Cozzolino C, et al. The prevalent comorbidity at the onset of psoriasis diagnosis. *Dermatol Ther*. 2023;13(9):2093–2105. doi:10.1007/s13555-023-00986-0
15. Azfar RS, Seminara NM, Shin DB, Troxel AB, Margolis DJ, Gelfand JM. Increased risk of diabetes mellitus and likelihood of receiving diabetes mellitus treatment in patients with psoriasis. *Arch Dermatol*. 2012;148(9):995–1000. doi:10.1001/archdermatol.2012.1401
16. Wan MT, Shin DB, Hubbard RA, Noe MH, Mehta NN, Gelfand JM. Psoriasis and the risk of diabetes: a prospective population-based cohort study. *J Am Acad Dermatol*. 2018;78(2):315–322.e311. doi:10.1016/j.jaad.2017.10.050
17. Zeng J, Luo S, Huang Y, Lu Q. Critical role of environmental factors in the pathogenesis of psoriasis. *J Dermatol*. 2017;44(8):863–872. doi:10.1111/1346-8138.13806
18. Boehncke WH, Boehncke S, Tobin AM, Kirby B. The ‘psoriatic march’: a concept of how severe psoriasis may drive cardiovascular comorbidity. *Exp Dermatol*. 2011;20(4):303–307. doi:10.1111/j.1600-0625.2011.01261.x
19. Späh F. Inflammation in atherosclerosis and psoriasis: common pathogenic mechanisms and the potential for an integrated treatment approach. *Br J Dermatol*. 2008;159(Suppl 2):10–17. doi:10.1111/j.1365-2133.2008.08780.x
20. Schlüter K, Diehl S, Lang V, Kaufmann R, Boehncke WH, Bürger C. Insulin resistance may contribute to upregulation of adhesion molecules on endothelial cells in psoriatic plaques. *Acta Derm Venereol*. 2016;96(2):162–168. doi:10.2340/00015555-2227
21. Mohamad N, Elshimi E. Relation between insulin resistance and severity of psoriasis in Egyptian patients. *Egypt J Dermatol Venerol*. 2020;40(1):29–33. doi:10.4103/ejdv.ejdv_20_19
22. Ikumi K, Odanaka M, Shime H, et al. Hyperglycemia is associated with psoriatic inflammation in both humans and mice. *J Invest Dermatol*. 2019;139(6):1329–1338.e1327. doi:10.1016/j.jid.2019.01.029
23. Polic MV, Miskulin M, Smolic M, et al. Psoriasis severity—a risk factor of insulin resistance independent of metabolic syndrome. *Int J Environ Res Public Health*. 2018;15(7):1486. doi:10.3390/ijerph15071486
24. American Diabetes Association. Diagnosis and classification of diabetes mellitus. *Diabetes Care*. 2010;33(Suppl 1):S62–S69. doi:10.2337/dc10-S062
25. American Diabetes Association Professional Practice Committee. 6. Glycemic Targets: standards of Medical Care in Diabetes-2022. *Diabetes Care*. 2022;45(Suppl 1):S83–S96. doi:10.2337/dc22-S006
26. Akasaka E, Mabuchi T, Manabe Y, et al. Long-term efficacy of psoriasis vulgaris treatments: analysis of treatment with topical corticosteroid and/or vitamin D3 analog, oral cyclosporin, etretinate and phototherapy over a 35-year period, 1975–2010. *J Dermatol*. 2013;40(4):238–243. doi:10.1111/1346-8138.12069
27. Alabas OA, Mason KJ, Yiu ZZN, et al. Effectiveness and persistence of Acitretin, ciclosporin, fumaric acid esters and methotrexate for patients with moderate-to-severe psoriasis: a cohort study from BADBIR. *Br J Dermatol*. 2023;188(5):618–627. doi:10.1093/bjd/ljad004

28. Enos CW, Ramos VL, McLean RR, et al. Cardiometabolic multimorbidity is common among patients with psoriasis and is associated with poorer outcomes compared to those without comorbidity. *J Dermatol Treat.* 2022;33(7):2975–2982. doi:10.1080/09546634.2022.2089329
29. Pinter A, Gerdes S, Papavassilis C, Reinhardt M. Characterization of responder groups to secukinumab treatment in moderate to severe plaque psoriasis. *J Dermatol Treat.* 2020;31(8):769–775. doi:10.1080/09546634.2019.1626973
30. Enos CW, Ramos VL, McLean RR, et al. Comorbid obesity and history of diabetes are independently associated with poorer treatment response to biologics at 6 months: a prospective analysis in Corrona Psoriasis Registry. *J Am Acad Dermatol.* 2022;86(1):68–76. doi:10.1016/j.jaad.2021.06.883
31. García-Doval I, Pérez-Zafrilla B, Ferrandiz C, et al. Development of clinical prediction models for good or bad response to classic systemic drugs, anti-TNFs, and ustekinumab in psoriasis, based on the BIOBADADERM cohort. *J Dermatol Treat.* 2016;27(3):203–209. doi:10.3109/09546634.2015.1088130
32. Romero-Jimenez RM, Escudero-Vilaplana V, Baniandres Rodriguez O, García Martín E, Mateos Mayo A, Sanjurjo Saez M. Association between clinical factors and dose modification strategies in the treatment with ustekinumab for moderate-to-severe plaque psoriasis. *J Dermatol Treat.* 2018;29(8):792–796. doi:10.1080/09546634.2018.1466978
33. Terui H, Asano M, Shimada-Omori R, et al. Body mass index, HbA1c and serum C-reactive protein are predictors of secondary failure in infliximab continuance for Japanese psoriasis patients: a hospital-based retrospective case-control study. *J Dermatol.* 2021;48(11):1719–1723. doi:10.1111/1346-8138.16096
34. Karpínska-Mirecka A, Bartosińska J, Krasowska D. The impact of hypertension, diabetes, lipid disorders, overweight/obesity and nicotine dependence on health-related quality of life and psoriasis severity in psoriatic patients receiving systemic conventional and biological treatment. *Int J Environ Res Public Health.* 2021;18(24):13167. doi:10.3390/ijerph182413167
35. Carretero G, Ribera M, Belinchón I, et al. Guidelines for the use of Acitretin in psoriasis. Psoriasis group of the spanish academy of dermatology and venereology. *Actas Dermosifiliogr.* 2013;104(7):598–616. doi:10.1016/j.ad.2013.01.003
36. Katz HI, Waalen J, Leach EE. Acitretin in psoriasis: an overview of adverse effects. *J Am Acad Dermatol.* 1999;41(3 Pt 2):S7–s12. doi:10.1016/S0190-9622(99)70359-2
37. Ling MR. Acitretin: optimal dosing strategies. *J Am Acad Dermatol.* 1999;41(3 Pt 2):S13–17. doi:10.1016/S0190-9622(99)70360-9
38. Norris D, Photiou L, Tacey M, et al. Biologics and dermatology life quality index (DLQI) in the Australasian psoriasis population. *J Dermatol Treat.* 2017;28(8):731–736. doi:10.1080/09546634.2017.1329501
39. Sun X, Cai X, Liu L, et al. Effect of different types of hypoglycemic medications on psoriasis: an analysis of current evidence. *Dermatology.* 2023;239(2):299–313. doi:10.1159/000528026
40. Shivanand D, Srikrishna R. Study of insulin resistance and dyslipidemia in psoriasis patients in a tertiary care hospital, South India. *J Krishna Inst Med Sci Univ.* 2016;5:14–19.
41. Gerdes S, Zahl VA, Weichenthal M, Mrowietz U. Smoking and alcohol intake in severely affected patients with psoriasis in Germany. *Dermatology.* 2010;220(1):38–43. doi:10.1159/000265557
42. Gupta MA, Schork NJ, Gupta AK, Ellis CN. Alcohol intake and treatment responsiveness of psoriasis: a prospective study. *J Am Acad Dermatol.* 1993;28(5 Pt 1):730–732. doi:10.1016/0190-9622(93)70101-X
43. Poikolainen K, Karvonen J, Pukkala E. Excess mortality related to alcohol and smoking among hospital-treated patients with psoriasis. *Arch Dermatol.* 1999;135(12):1490–1493. doi:10.1001/archderm.135.12.1490
44. Kirby B, Richards HL, Mason DL, Fortune DG, Main CJ, Griffiths CE. Alcohol consumption and psychological distress in patients with psoriasis. *Br J Dermatol.* 2008;158(1):138–140. doi:10.1111/j.1365-2133.2007.08299.x

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