

# A Comparison of Clinical Characteristics in Overweight/Obese and Normal Weight Patients with Psoriasis Vulgaris: A Bicentric Retrospective Observational Study

Lanzhi Li<sup>1,\*</sup>, Keshuai Liu<sup>1,\*</sup>, Xingwu Duan<sup>1</sup>, Limei Xu<sup>2</sup>, Qingqi Yang<sup>2</sup>, Fang Liu<sup>2</sup>

<sup>1</sup>Department of Dermatology, Dongzhimen Hospital, Beijing University of Chinese Medicine, Beijing, People's Republic of China; <sup>2</sup>Department of Dermatology, Air Force Medical Center of PLA, Beijing, People's Republic of China

\*These authors contributed equally to this work

Correspondence: Xingwu Duan, Email [xwduan@sina.com](mailto:xwduan@sina.com)

**Background:** Psoriasis is a chronic, inflammatory skin disease that is often accompanied by multiple comorbidities. Obesity is considered an independent risk factor for the development of psoriasis. However, most of the related data are derived from epidemiological studies conducted in the United States of America and Europe. This study aimed to compare the clinical characteristics of patients with psoriasis who are overweight/obese and patients with psoriasis with normal weight in China.

**Methods:** We reviewed the medical records of 208 patients with psoriasis. Based on their body mass index (BMI), the patients were divided into two groups: patients with psoriasis who were overweight/obese and patients with psoriasis with normal weight.

**Results:** The most patients enrolled in this study were men (77.40%). Patients with psoriasis who were overweight/obese had a higher mean age, longer disease duration, and significantly higher Psoriasis Area and Severity Index (PASI) values ( $P=0.032$ ). Additionally, the incidence of fatty liver, hyperlipidemia, hyperuricemia, and abnormal liver function was higher among patients with psoriasis who were overweight/obese ( $P<0.05$ ). Linear regression analysis revealed a linear relationship between PASI values and BMI ( $P=0.016$ ). Moreover, patients with psoriasis who were overweight/obese had significantly higher levels of serum alanine transaminase (ALT), aspartate transaminase (AST), uric acid (UC), total cholesterol (TC), low-density lipoprotein (LDL), and fasting plasma glucose (FPG) ( $P<0.05$ ) and lower serum high-density lipoprotein (HDL) levels and absolute lymphocyte count (ALC) ( $P<0.05$ ).

**Conclusion:** Patients with psoriasis who are overweight/obese have more severe psoriatic lesions and metabolic comorbidities. Detailed assessment of the BMI of patients with psoriasis revealed that weight loss may be necessary for patients who are overweight/obese to reduce the risk of metabolic disorders.

**Keywords:** psoriasis, obesity, metabolic disorders

## Introduction

Psoriasis vulgaris is a chronic, inflammatory skin disease characterized by abnormal proliferation and differentiation of keratinocytes. Recent studies have demonstrated that psoriasis vulgaris is associated with comorbidities including cardiovascular disease, obesity, type 2 diabetes mellitus (T2DM), and nonalcoholic fatty liver disease (NAFLD).<sup>1,2</sup> As one of the important comorbidities, obesity is considered an independent risk factor for the onset of psoriasis vulgaris.<sup>3</sup> With an increase in body mass index (BMI), the prevalence of psoriasis also increases.<sup>4,5</sup> A study from the UK and Norway showed that for every 1 kg/m<sup>2</sup> increase in BMI in patients with obesity, the incidence of psoriasis increases by 4%.<sup>4</sup> Another retrospective study involving 1.5 million people reported that the incidence of psoriasis was significantly higher in individuals with obesity than in individuals with normal weight and increased with an increase in weight.<sup>5</sup> Obesity not only worsens the clinical outcome of psoriasis but also increases the likelihood of developing adverse events,

such as delayed response to biological therapy<sup>6</sup> and increased risk of hyperlipidemia during treatment with methotrexate and acitretin.<sup>7,8</sup> However, weight loss could reduce the severity of skin lesions and improve the quality of life of patients with psoriasis.<sup>9–13</sup> At present, studies investigating the clinical characteristics of patients with psoriasis who are overweight/obese are lacking.<sup>4,5,14,15</sup> Although relevant information is available in several related studies, most data are derived from epidemiological studies conducted in Europe and the USA.<sup>16,17</sup> Therefore, this study aimed to investigate the clinical characteristics of Chinese patients with psoriasis to elucidate the relationship between psoriasis and obesity.

## Materials and Methods

This study conformed to the ethical guidelines of the Declaration of Helsinki. The Ethics Committee of Dongzhimen Hospital Affiliated to Beijing University of Chinese Medicine approved the research (Registration number:2022DZMEC-494-01). Patient consent is not required for this retrospective study. We used an electronic medical record database to review the data of patients with psoriasis who visited the dermatology ward of Dongzhimen Hospital of Beijing University of Chinese Medicine and Air Force Medical Center of PLA from January 2022 to December 2022. The diagnosis of all patients with psoriasis was confirmed based on the ICD code in their medical records.

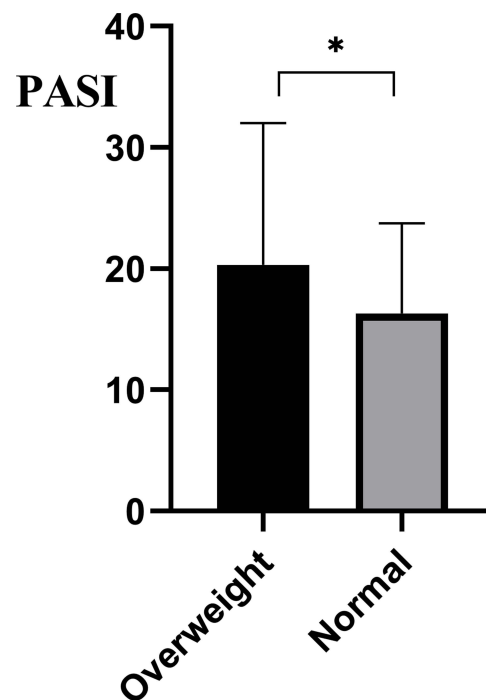
All patients were registered with basic information (gender, age, height, weight, the history of smoking, the history of drinking alcohol, the positive family history of psoriasis, etc.), PASI score, comorbidities, blood tests (WBC, RBC, PLT, ANC, ALC, MONO, CRP, IL-6, ALT, AST, TBiL, UA, LPA, TG, TC, etc.) and abdominal ultrasound examination before starting treatment. We collected the above information and input this data into an Excel table for analysis. The patients were divided into the overweight/obesity and normal weight groups according to their BMI values. Baseline data and serological indicators were compared between the two groups. The diagnostic criteria for obesity were as follows: Given that the World Health Organization (WHO) standards are mainly formulated for European and American countries, we adopted the standards recommended by the Working Group on Obesity of China (WGOC) of the International Life Sciences Institute (ILSI) to define overweight and obesity in Chinese adults and conform to the actual prevalence of obesity in China.  $28 > \text{BMI} \geq 24$  and  $\text{BMI} \geq 28$  were considered overweight and obese, respectively.<sup>18</sup>

Excel 2016 was used to record the data, and the SPSS Statistics (version 24.0) software was used for statistical analysis. Data conforming to a normal distribution were expressed as mean $\pm$ standard, whereas those not conforming to a normal distribution were expressed as the median (P25, P75). The *t*-test was used to compare normally distributed continuous variables between groups. Student's *t*-test was used if the distribution was normal and the variance was homogeneous, whereas Welch's *t*-test was used if the variance was unequal. The Mann–Whitney *U*-test was used to compare data that did not conform to a normal distribution, and Pearson's chi-square test was used to compare dichotomous variables between groups. A *p*-value of  $<0.05$  indicated statistical significance.

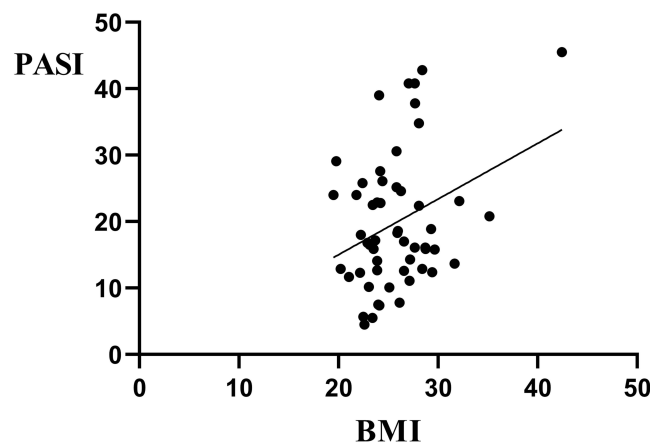
## Results

### Characteristics of Patients

This retrospective cross-sectional study included 208 patients with psoriasis vulgaris, with an average age of  $41.98 \pm 17.02$  years and a median disease duration of 10 years. The prevalence of overweight and obesity was 36% and 26%, respectively. The patients were divided into the overweight/obesity ( $\text{BMI} \geq 24$ ; 129 cases) and normal weight ( $\text{BMI} < 24$ ; 79 cases) groups according to their BMI values. Age and disease duration were significantly higher in the overweight/obesity group than in the normal weight group (mean age:  $44.19 \pm 15.46$  years versus  $38.37 \pm 18.84$  years, respectively,  $P=0.022$ ; median duration of disease: 12 years versus 5 years, respectively,  $P<0.001$ ). Furthermore, most patients were men (male/female patients [M/F]: 161/47; 77.40%/22.60%), and no significant difference was observed in sex distribution between the overweight/obesity (M: 104, 80.6%) and normal weight (M: 57, 72.2%) groups ( $P=0.156$ ). The PASI scores of patients in the overweight/obesity group were significantly higher than those of patients in the normal weight group (median: 18.90 and 15.90, respectively,  $P=0.032$ ) (Figure 1). Linear regression analysis revealed that BMI was linearly correlated with PASI scores in all patients ( $P=0.016$ ). This finding suggests that the severity of psoriasis increases with an increase in BMI (Figure 2). Moreover, no significant differences were observed in the history of



**Figure 1** Comparison of PASI scores between the two groups before treatment. \* $P<0.05$ .



**Figure 2** Linear correlation analysis of BMI and PASI scores.

drinking alcohol, the history of smoking, psoriasis nail and bunched hair between the two groups ( $P>0.05$ ). The basic characteristics of the patients are shown in [Table 1](#).

### Analysis of Comorbidities and Hematological Indicators

A total of 176 patients underwent ultrasound examination. The results revealed that 85.7% (78 cases) of patients with psoriasis who were overweight/obese and 14.3% (13 cases) of patients with psoriasis with normal weight had fatty liver ( $P<0.001$ ). The incidence of hyperlipidemia ( $P=0.011$ ), hyperuricemia ( $P<0.001$ ), and abnormal liver function ( $P=0.036$ ) was significantly higher in the overweight/obesity group than in the normal weight group; however, the incidence of hypertension ( $P=0.06$ ), T2DM ( $P=0.406$ ), and other complications was not significantly different between the two groups. In terms of hematological indices, RBC count ( $P=0.000$ ), ALT levels ( $P=0.001$ ), AST levels ( $P=0.021$ ), UA levels ( $P=0.000$ ), TC levels ( $P=0.041$ ), LDL levels ( $P=0.000$ ) and FPG levels ( $P=0.036$ ) were higher in the overweight/

**Table 1** Basic Characteristics of the Included Patients

	Total	Overweight/Obesity Group (n=129)	Normal Weight Group (n=79)	p-value
Age, years	41.98 ± 17.02	44.19 ± 15.46	38.37 ± 18.84	0.022
Sex (male/female patients)	161/47	104/25	57/22	0.156
Duration of psoriasis, years	10.00 (2.00, 18.75)	12.00 (4.00, 20.00)	5 (1.00, 14.00)	<0.001
BMI, kg/m <sup>2</sup>	25.34 ± 4.51	27.94 ± 3.35	21.08 ± 2.44	-
BSA	11.00 (8.00, 14.00)	11.50 (8.00, 16.00)	10.00 (7.00, 11.25)	0.063
PASI scores	17.10 (12.68, 24.75)	18.90 (14.00, 29.10)	15.90 (10.95, 22.70)	0.032
Smoking, n (%)	76 (36.5%)	51 (39.5%)	25 (31.6%)	0.251
Drinking alcohol, n (%)	23 (11.1%)	14 (10.9%)	9 (11.4%)	0.904
Positive family history of psoriasis, n (%)	36 (17.3%)	24 (18.6%)	12 (15.2%)	0.528
Bunchy hair, n (%)	64 (30.8%)	43 (33.3%)	21 (26.6%)	0.306
Psoriasis nail, n (%)	57 (27.4%)	40 (31.0%)	17 (21.5%)	0.136

obesity group than in the normal weight group, whereas HDL levels ( $P=0.024$ ) and ALC ( $P=0.047$ ) were lower in the overweight/obesity group than in the normal weight group. Moreover, no significant difference was observed in complement C3 levels ( $P=0.070$ ), complement C4 levels ( $P=0.882$ ), IL-6 levels ( $P=0.645$ ), C-reactive protein levels ( $P=0.178$ ), and lipoprotein A levels ( $P=0.822$ ) between the two groups (Table 2).

**Table 2** Complications and Hematological Indices

	Total	Overweight/Obesity Group (n = 129)	Normal Weight Group (n = 79)	p-value
Fatty liver, n (%)	91 (51.7%)	78 (67.2%)	13 (21.7%)	<0.001
Hyperlipidemia, n (%)	79 (39.9%)	58 (46.8%)	21 (28.4%)	0.011
Hyperuricemia, n (%)	61 (30.2%)	51 (40.2%)	10 (13.3%)	<0.001
Hypertension, n (%)	46 (22.1%)	34 (26.4%)	12 (15.2%)	0.06
Diabetes, n (%)	29 (13.9%)	20 (15.5%)	9 (11.4%)	0.406
Liver dysfunction, n (%)	29 (14.2%)	23 (18.3%)	6 (7.7%)	0.036
WBC, 10 <sup>9</sup> /L	7.61 ± 2.64	7.71 ± 2.59	7.46 ± 2.72	0.496
RBC, 10 <sup>12</sup> /L	4.65 ± 0.52	4.76 ± 0.5	4.46 ± 0.48	0.000
PLT, 10 <sup>9</sup> /L	230.92 ± 64.65	229.59 ± 68.15	233.12 ± 58.77	0.707
ANC, 10 <sup>9</sup> /L	4.50 (3.30, 5.90)	4.57 (3.44, 6.14)	4.40 (3.07, 5.34)	0.150
ALC, 10 <sup>9</sup> /L	1.87 ± 0.65	1.80 ± 0.63	1.98 ± 0.65	0.047
MONO, 10 <sup>9</sup> /L	0.50 (0.40, 0.60)	0.50 (0.40, 0.60)	0.50 (0.40, 0.60)	0.693
CRP, mg/dL	4.75 (1.87, 10.75)	5.15 (2.43, 9.65)	2.75 (1.54, 11.75)	0.178

(Continued)

**Table 2** (Continued).

	Total	Overweight/Obesity Group (n = 129)	Normal Weight Group (n = 79)	p-value
IL-6, pg/mL	5.18 ± 4.75	5.42 ± 5.15	4.75 ± 4.03	0.645
ALT, U/L	20.00 (15.00, 30.00)	22.00 (16.00, 34.00)	18.00 (13.00, 25.00)	0.001
AST, U/L	20.00 (16.00, 26.00)	21 (17.00, 27.50)	18.00 (15.25, 25.00)	0.021
TBiL, umol/L	11.44 ± 5.3	11.89 ± 5.38	10.67 ± 5.09	0.113
UA, umol/L	372.57 ± 100.88	396.49 ± 101.45	332.07 ± 86.45	0.000
LPA, g/L	98.00 (46.00, 203.50)	99.0 (48.50, 220.00)	94.50 (44.50, 201.25)	0.822
TG, mmol/L	1.59 ± 1.0	1.65 ± 0.82	1.49 ± 1.24	0.265
TC, mmol/L	4.30 ± 0.86	4.40 ± 0.81	4.14 ± 0.91	0.041
HDL, mmol/L	1.09 ± 0.28	1.06 ± 0.27	1.15 ± 0.31	0.024
LDL, mmol/L	2.60 ± 0.67	2.73 ± 0.64	2.39 ± 0.68	0.000
FPG, mmol/L	5.57 ± 1.73	5.75 ± 1.85	5.25 ± 1.47	0.036
C3, g/L	1.04 ± 0.17	1.07 ± 0.17	0.98 ± 0.17	0.070
C4, g/L	0.24 ± 0.07	0.24 ± 0.07	0.24 ± 0.07	0.882

**Abbreviations:** WBC, white blood cell; RBC, red blood cell; PLT, platelet; ANC, absolute neutrophil count; ALC, absolute lymphocyte count; MONO, monocyte; CRP, C-reactive protein; IL-6, interleukin 6; ALT, alanine transaminase; AST, aspartate transaminase; TBiL, total bilirubin; UA, uric acid; LPA, lipoprotein A; TG, levels of triglyceride; TC, total cholesterol; HDL, high-density lipoprotein; LDL, low-density lipoprotein; HLD, high-density lipoprotein; LDL, low-density lipoprotein; FPG, fasting plasma glucose; C3, Complement 3; C4, Complement 4.

## Discussion

As a chronic inflammatory skin disease, psoriasis is often accompanied by multiple systemic comorbidities. Obesity is one of the common comorbidities and an independent risk factor for psoriasis.<sup>10</sup> Some studies have suggested that patients with psoriasis have a higher risk of developing obesity than those without psoriasis (OR=1.66), and the risk of obesity is significantly higher in patients with severe psoriasis than in patients with mild psoriasis.<sup>19</sup> Additionally, obesity could increase the risk of psoriasis.<sup>20</sup> As a low-grade chronic inflammatory organ, the adipose tissue of patients with obesity contains various immune cells. Inflammatory cells and factors are closely related to the occurrence and development of obesity and psoriasis.<sup>21–25</sup> In this study, psoriatic lesions were more severe in patients who were overweight/obese, and the severity of lesions increased with an increase in BMI in all patients. These results are consistent with those of previous studies.<sup>26</sup> A reason underlying this phenomenon is that the imbalance between pro-inflammatory and anti-inflammatory factors in patients who are overweight/obese could result in chronic inflammation. Several studies have demonstrated that the adipose tissue of patients with obesity secretes more pro-inflammatory cytokines (TNF- $\alpha$ , IL-6, IFN- $\gamma$ , IL-17A, leptin, visfatin, and chemokines)<sup>27</sup> and less anti-inflammatory cytokines (adiponectin).<sup>28</sup> These inflammatory factors can activate the inflammatory pathway and upregulate the secretion of IL-6, IL-8, and other pro-inflammatory cytokines, leading to increased inflammation.<sup>23</sup> In a study on mouse models of psoriasis with obesity fed a high-fat diet (HFD), activation of the NLRP3 inflammasome induced the production of pro-inflammatory cytokines, such as IL-17A, IL-1 $\beta$ , and IL-18, in innate lymphoid cells (ILCs) and macrophages, thereby aggravating psoriasis.<sup>22</sup> Leptin can stimulate the proliferation of keratinocytes<sup>29</sup> and is highly expressed in the serum<sup>30</sup> and skin lesions of patients with psoriasis.<sup>31</sup> Visfatin is elevated in the serum of patients with psoriasis and is positively correlated with PASI scores.<sup>32</sup> Visfatin and TNF- $\alpha$  can synergistically stimulate keratinocytes to produce chemokines and antimicrobial peptides via the NF- $\kappa$ B and STAT3 pathways.<sup>33</sup> The levels of the anti-inflammatory factor adiponectin are negatively correlated with PASI scores and the expression of IL-6 and TNF- $\alpha$ .<sup>34</sup> Adiponectin may exert anti-

inflammatory effects by inhibiting the expression of adhesion molecules induced by TNF- $\alpha$  and the production of IFN- $\gamma$ .<sup>35</sup> The above-mentioned studies suggest that psoriasis and obesity share a common inflammatory pathway, which may explain the effects of obesity on the development of psoriasis; however, the molecular mechanisms underlying this inflammatory pathway remain unclear.

In this study, patients with psoriasis were found to have dyslipidemia of varying degrees, which is consistent with the results of previous studies. A systematic review that included 25 observational studies demonstrated that psoriasis is significantly associated with dyslipidemia, and the incidence of hyperlipidemia is significantly increased in patients with psoriasis.<sup>36</sup> Furthermore, compared with the normal weight group, the overweight/obesity group had a higher incidence of hyperlipidemia ( $P=0.011$ ) and significantly higher total cholesterol levels ( $P=0.041$ ). Additionally, the levels of LDL and HDL, important indicators of lipid metabolism, were significantly abnormal. LDL levels were higher ( $P=0.000$ ) and HDL levels were lower ( $P=0.024$ ) in the overweight/obesity group than in the normal weight group. These results are consistent with those of a previous study from the UK.<sup>37</sup> Elevated levels of pro-inflammatory cytokines such as IL-17A and IL-6 can lead to an increase in LDL-L levels and a decrease in HDL-L levels, which may be caused by the enhancement of HDL catabolism owing to the acute inflammatory reaction of hepatocytes caused by IL-17A and IL-6.<sup>38</sup> Widawski et al reported a higher BMI in patients with hyperuricemia (30.9 versus 28.7 kg/m<sup>2</sup>,  $P=0.015$ ) in a retrospective two-center case-control study on psoriatic arthritis.<sup>39</sup> Another study from China reported that hyperuricemia was associated with a higher BMI, and the prevalence of hyperuricemia was higher in patients with psoriasis who were overweight/obese than in those with normal weight.<sup>40</sup> Consistently, in this study, the incidence of hyperuricemia was significantly different between the overweight/obesity and normal weight groups ( $P<0.001$ ). Increased body weight may be a major factor involved in the elevation of serum urate levels in psoriasis patients.<sup>41</sup> NAFLD is one of the most common comorbid systemic diseases in patients with psoriasis, and several previous studies have validated that psoriasis is associated with NAFLD (OR=1.96).<sup>42</sup> In the present study, the incidence of fatty liver and liver dysfunction was higher in the overweight/obesity group than in the normal weight group, which is consistent with the results of a cross-sectional study from Iran.<sup>43</sup>

Furthermore, the levels of FPG, TC, and LDL were higher and those of HDL were lower in the overweight/obesity group than in the normal weight group. Significant differences were observed between the two groups, and these differences may be attributed to the disorder of glucose and lipid metabolism caused by insulin resistance. Studies have demonstrated that Th17 cells in the peripheral blood of patients with psoriasis can downregulate the expression of the transcription factor Foxp3 by secreting cytokines such as IL-17A, which inhibits the expression of the insulin gene and leads to a decrease in insulin secretion.<sup>44</sup> Additionally, obesity can induce insulin resistance through the secretion of adipose tissue factors, further exacerbating glucose and lipid metabolism disorders.<sup>45</sup> In this study, absolute lymphocyte counts were lower in the overweight/obesity group than in the normal weight group, suggesting a decrease in immune function in patients in the overweight/obesity group, which may be related to the inflammatory status of obesity. However, no significant changes were observed in complement C3 and C4 levels between the two groups, which may be attributed to the sample size and warrants further investigation. Additionally, patients with psoriasis who were overweight/obese were older and had a longer disease duration, which may be attributed to the poor outcomes of psoriasis owing to overweight/obesity and the recurrence of the disease.

We also observed in this study that the proportion of male patients with psoriasis who were overweight/obese was higher (M/F: 104/25). We speculate that this difference is related to lifestyle habits. On the one hand, men have a higher consumption of smoking and alcohol; on the other hand, women may be protected by estrogen. Studies have demonstrated that the incidence of metabolic syndrome is significantly lower in premenopausal women than in men but higher in postmenopausal women than in men.<sup>46</sup> Additionally, no difference was observed in the psoriasis nail and bumpy hair between the two groups, which may be related to personal factors such as negligence in assessment by medical workers.

In conclusion, considering the crosstalk between psoriasis and obesity, we recommend weight loss as one of the interventions for patients with psoriasis who are overweight/obese. Healthy dietary patterns such as the Mediterranean diet have been reported to be beneficial not only for weight loss but also for the alleviation of psoriasis.<sup>47</sup> A low-calorie ketogenic diet (VLCKD) may reduce the severity of psoriasis by reducing weight and chronic inflammation.<sup>48</sup> There is no unanimous opinion on the type and duration of exercise for patients with psoriasis with obesity, and because strenuous

exercise may cause some damage to the joints of patients with psoriasis who are overweight/obese, moderate-intensity aerobic exercise, such as calisthenics, jogging, and ball games, may be more appropriate. Aerobic training burns more energy than resistance training<sup>49</sup> and is enjoyable and acceptable to patients.<sup>50</sup> Based on the combined analysis of data from several studies, patients with psoriasis vulgaris with obesity should adhere to aerobic exercise 3-5 times per week, with a duration of  $\geq 30$  minutes each time, to lose approximately 1 kg per month on the basis of diet management.<sup>51</sup> This study has the following limitations: (1) this study had a retrospective design, and there may be potential information bias; (2) this study had a cross-sectional design; therefore, we could not accurately determine the causal relationship between obesity and psoriasis.

## Conclusion

This study suggests that over 60% patients with psoriasis vulgaris suffer from overweight/obesity. Patients with higher BMI values tend to have more severe skin lesions and metabolic disorders. Therefore, the BMI of patients with psoriasis should be monitored and lifestyle changes, such as dietary habits and exercise patterns, should be promptly implemented to improve patient outcomes.

## Ethics Approval

This study was approved by the Ethics Committee of Dongzhimen Hospital Affiliated to Beijing University of Chinese Medicine (Registration number:2022DZMEC-494-01). This retrospective study conformed to the ethical guidelines of the Declaration of Helsinki, and patients' privacy and personal identity information are protected. Exemption from informed consent will not have any adverse impact on patients' health and rights. Therefore, the patient consent is not required for this retrospective study.

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## Disclosure

The authors report no conflicts of interest in this work.

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