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ARTICLE

Predictive Value of Dietary Inflammatory Index for Recurrence of Plaque Psoriasis—A Retrospective Study

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Abstract

Aims/Background Determining the predictive value of dietary inflammatory index on the recurrence of plaque psoriasis vulgaris is an emerging research area. This study aims to investigate the predictive value of the dietary inflammatory index (DII) for the recurrence of plaque psoriasis.

Methods A retrospective study was conducted on 200 patients with plaque psoriasis who were treated at the China-Japan Friendship Hospital from October 2022 to December 2023. Patients were divided into the recurrence group (n = 95) and the non-recurrence group (n = 105) based on whether they had experienced a recurrence during follow-up. Univariate and multivariate logistic regression analyses were performed to determine the influencing factors of plaque psoriasis recurrence. The receiver operating characteristic (ROC) curve was used to evaluate the predictive value of the DII for plaque psoriasis recurrence.

Results Comparisons of age, gender, Drinking, duration of illness, family history, season of onset, and history of skin allergies showed no statistically significant differences between the recurrence group and non-recurrence group ($p > 0.05$). However, comparisons of sleep inadequacy, anxiety, smoking, infections, and DII showed statistically significant differences between the recurrence group and non-recurrence group ($p < 0.05$). The results of the multivariate logistic regression analysis indicated that sleep inadequacy, anxiety, smoking, infections, and DII were independent influencing factors for the recurrence of plaque psoriasis ($p < 0.05$). The ROC analysis results showed that the predicted area under the curve of DII in predicting recurrence of plaque psoriasis vulgaris was 0.815, and the standard error was 0.031 (95% confidence interval (CI): 0.754–0.877, $p < 0.001$) with a Youden's index of 0.60, sensitivity of 74.7%, and specificity of 84.8%. DII has the highest predictive value.

Conclusion Characterized by high specificity and sensitivity from the ROC curve analysis, the DII exhibits a high predictive value for plaque psoriasis recurrence.

Key words: psoriasis; predictive value of test; plaque

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Introduction

Plaque psoriasis is a common chronic immune-mediated inflammatory skin disease with a genetic predisposition, having a prevalence rate of approximately 2% to 3% worldwide and around 0.47% in China (Berki et al, 2015). The disease is characterized by both local and systemic inflammation, and although undefined, its pathogenesis is likely multifactorial, involving immune cells and cytokines (Ding et al, 2024). The progress in plaque psoriasis research in recent years has led to a

growing recognition of the significant role of inflammation in the onset and recurrence of plaque psoriasis (Guo et al, 2024).

The dietary inflammatory index (DII) is a measure of diet-induced inflammatory response, assessing the anti-inflammatory or pro-inflammatory potential of various food components in the daily diet to provide an overall score. This index is created based on extensive literature research (Hua et al, 2024), taking into account a variety of inflammation-related food components such as ω-3 and ω-6 polyunsaturated fatty acids, antioxidants, iron, dietary fiber (Liu, 2024; Lu et al, 2024). Previous studies have indicated a close association between DII and the risk and prognosis of various chronic diseases, including cardiovascular diseases, diabetes, and certain cancers (Mohajeri and Cicero, 2024; Morichika et al, 2016). However, research on the predictive value of DII for the recurrence of plaque psoriasis remains scarce.

Given the high recurrence rate of plaque psoriasis and the inflammatory mechanisms involved in its pathogenesis, exploring the predictive value of DII for disease recurrence holds significant clinical and research importance. Understanding the relationship between patients' dietary habits and plaque psoriasis recurrence can provide a theoretical basis for developing personalized dietary interventions to help patients reduce the risk of recurrence and improve their quality of life by adjusting their dietary structure.

The current study aims to investigate the predictive value of DII for the recurrence of plaque psoriasis through a retrospective analysis, offering important references and insights for future investigations. Plaque psoriasis vulgaris, the most common type of plaque psoriasis, was chosen to investigate the predictive value of DII in its recurrence. This particular psoriasis subtype has a high incidence, a long pathological course and higher susceptibility to recurrence, bringing huge challenges to the affected patients' daily lives. Unraveling the relationship between the DII and the recurrence of plaque psoriasis vulgaris is crucial for controlling the disease, reducing recurrence, and improving patients' quality of life through personalization of their dietary patterns.

Methods

Research Subjects

Two hundred patients who had recovered from plaque psoriasis vulgaris, admitted to the Dermatology Outpatient Department of China-Japan Friendship Hospital from October 2022 to December 2023, were retrospectively selected for this investigation.

Inclusion and Exclusion Criteria

Inclusion Criteria

The inclusion criteria for this study are as follows:

(1) Patients who meet the clinical diagnosis criteria for plaque psoriasis (Abo-Tabik et al, 2021);

(2) Patients with complete clinical data;

(3) Patients with complete follow-up data and no premature withdrawal;
(4) Patients aged 18 to 70 years old.

Exclusion Criteria

The exclusion criteria for this study are as follows:
(1) Patients with other types of plaque psoriasis;
(2) Patients with severe liver or kidney dysfunction;
(3) Patients with hematologic or immunological disorders;
(4) Patients with systemic infections.

Research Methods

General patient information was gathered from an electronic medical record system, and further details were supplemented through interviews. Patients were divided into a recurrence group (n = 95) and a non-recurrence group (n = 105) based on follow-up outcomes.

According to the Foundation of the International Plaque Psoriasis Society, which had conducted research on recurrent events of plaque psoriasis recurrence, the plaque psoriasis recurrence is defined as the recurrence of the pathological condition in individuals who have achieved effective clinical cure. Clinical effectiveness is defined as an improvement of at least 50% from baseline in the plaque psoriasis lesion area and severity index (Bellinato et al, 2019). For patients who respond to treatment, recurrence is called when their Psoriasis Area and Severity Index (PASI) score rises from baseline to more than 50%. Some scholars also opine that a 5-point increase in PASI score compared with the previously recorded one is indicative of a recurrence, irrespective of the baseline PASI (Gamradt et al, 2019). In addition, there is no defined grading system for plaque psoriasis recurrence, and the UK Guidelines for Plaque Psoriasis Biologics define rapid recurrence as a 50% reduction in PASI score improvement within 3 months upon treatment completion (National Clinical Guideline Centre (UK), 2012). The plaque psoriasis recurrence generally constitutes a more severe form of the disease, which affects human health in a more comprehensive manner, compared with the first-onset condition.

In this study, we define plaque psoriasis recurrence as recurrence following the successful achievement of effective clinical cure. Clinical effectiveness is defined as at least a 50% improvement in plaque psoriasis lesion area and severity index from baseline. For patients having had clinically effective treatment, a recurrence is defined as an increase in PASI score by more than 50% from baseline.

The DII was measured as previously described (Shivappa et al, 2014): (1) Standardization process: When calculating Z-scores, dietary intake of food components is standardized by subtracting the global mean and dividing by the standard deviation. This standardization is necessary because their units and distribution ranges may vary. (2) Centralization process: Transforming Z-scores into percentile values (n) and constraining them within a range of –1 to +1, centered on 0, further ensures uniform distribution and comparability of data. This step helps reduce the excessive impact of outliers on the overall DII. (3) Weight adjustment: In the calculation of DII, each dietary component is assigned a specific inflammation score (b), reflect-

ing its potential impact on inflammatory responses. By adjusting these weights, researchers can more accurately assess the contributions of different dietary components to the overall DII. (4) Outlier handling: In data processing, truncation, replacement, or deletion methods are employed to identify and address outliers.

The overall DII can be computed as follows (Shivappa et al, 2014):

$DII = n_1 \times b_1 + n_2 \times b_2 \ldots\ldots n_{28} \times b_{28}$

Pittsburgh Sleep Quality Index (PSQI) (Buysse et al, 1989), including 7 items, with each item rated with a scale of 0–3 points and the total score ranging from 0 to 21 points, was employed to assess sleep adequacy. The critical value for defining the quality of sleep is 7 points. A score $\geq$7 points indicates that the patient may suffer from sleep disorders.

Anxiety was evaluated using the Generalized Anxiety Disorder-7 (GAD-7) scale (Spitzer et al, 2006), which contains 7 items, each item rated on a scale of 0–3 points, with the total score ranging from 0 to 21 points. Anxiety assessed using this standardized scale can be divided into four classifications depending on the points gained: (i) no obvious anxiety symptoms (0–4 points), (ii) mild anxiety symptoms (5–9 points), (iii) moderate anxiety symptoms (10–14 points), and (iv) severe anxiety symptoms (15–21 points).

A complete deletion method was used as an approach to handling missing data by directly deleting observations with missing values.

Statistical Analysis

The experimental data collected were analyzed using SPSS 27.0 (IBM, Armonk, NY, USA). The Shapiro-Wilk test was used to assess the normality of data distribution. Bartlett's test was performed on the data to ensure that their variances were homogeneous. Continuous data that conformed to a normal distribution are represented as mean $\pm$ standard deviation (mean $\pm$ SD). Independent sample *t*-tests were used for comparisons. Categorical data are expressed as counts or rates, while their comparisons were conducted using chi-square test. Factors influencing the recurrence of plaque psoriasis were analyzed with univariate and multivariate logistic regression analyses. The predictive value of the DII for plaque psoriasis recurrence was evaluated using receiver operating characteristic (ROC) curves. A difference was considered statistically significant at $p < 0.05$.

Results

Univariate Analysis of Factors Influencing Recurrence of Plaque Psoriasis

A comparison of age, sex, Drinking, duration of illness, family history, onset season, and history of skin allergies showed no statistically significant differences ($p > 0.05$). However, differences were statistically significant ($p < 0.05$) for comparisons involving sleep inadequacy, anxiety, smoking, infections, and DII, as shown in Table 1.

Multivariate Logistic Regression Analysis of Influencing Factors

A multivariate logistic regression analysis was conducted with recurrence as the dependent variable (recurrence = 1, non-recurrence = 0), and sleep inadequacy,

Table 1. Univariate analysis of factors influencing recurrence of plaque psoriasis.

Characteristic	Recurrence group (n = 95)	Non-recurrence group (n = 105)	t/χ^2 value	p-value
Age (years)	49.67 ± 6.64	50.09 ± 5.97	0.47	0.638
Sex			0.19	0.661
Male	50 (52.63)	52 (49.52)		
Female	45 (47.37)	53 (50.48)		
Smoking			6.75	0.009
Yes	46 (48.42)	32 (30.48)		
No	49 (51.58)	73 (6.52)		
Drinking			0.61	0.434
Yes	40 (42.11)	50 (47.62)		
No	55 (57.89)	55 (52.38)		
Duration of illness (years)			0.01	0.935
<5	34 (35.79)	37 (35.24)		
≥5	61 (64.21)	68 (64.76)		
Family history			0.54	0.461
Yes	43 (45.26)	53 (50.48)		
No	52 (54.74)	52 (49.52)		
Sleep inadequacy			36.79	<0.0001
Yes	67 (70.53)	29 (27.62)		
No	28 (29.47)	76 (72.38)		
Infections			14.02	0.0002
Yes	29 (30.53)	10 (9.52)		
No	66 (69.47)	95 (90.48)		
Anxiety			34.15	<0.001
None or mild	18 (18.95)	33 (31.43)		
Moderate	20 (21.05)	51 (48.57)		
Severe	57 (60.00)	21 (20.00)		
DII	1.11 ± 0.29	0.78 ± 0.18	9.77	<0.0001
Onset season			2.87	0.412
Spring	22 (23.16)	24 (22.86)		
Summer	25 (26.32)	26 (24.76)		
Autumn	20 (21.05)	32 (30.48)		
Winter	28 (29.47)	23 (21.90)		
History of skin allergies			0.28	0.596
Yes	12 (12.63)	16 (15.24)		
No	83 (87.37)	89 (84.76)		

DII, dietary inflammatory index.

anxiety, smoking, infections, and DII as the independent variables. The value assignments are presented in Table 2. The analysis showed that sleep inadequacy, anxiety, smoking, infections, and DII are independent influencing factors for the recurrence of plaque psoriasis ($p < 0.05$), as detailed in Table 3.

Table 2. Value assignment for independent variables assessed in the multivariate logistic regression analysis.

Factor	Value assignment
Sleep inadequacy	Yes = 1, No = 0
Anxiety	None or mild = 0, Moderate = 1, Severe = 2
Smoking	Yes = 1, No = 0
Infections	Yes = 1, No = 0
DII	The exact values

DII, dietary inflammatory index.

Table 3. Multivariate logistic regression analysis of influencing factors.

Factor	Beta coefficient	Standard error	Wald	*p*	Exp(B)	95% CI	
						Lower limit	Upper limit
Sleep inadequacy (= 1)	1.729	0.421	16.852	<0.001	5.638	2.469	12.874
Anxiety	-	-	13.539	0.001	-	-	-
Anxiety (= 1)	–0.320	0.554	0.335	0.563	0.726	0.245	2.148
Anxiety (= 2)	1.355	0.544	6.213	0.013	3.878	1.336	11.258
Smoking (= 1)	1.060	0.451	5.521	0.019	2.887	1.192	6.990
Infections (= 1)	1.372	0.554	6.143	0.013	3.943	1.332	11.670
DII	0.515	0.094	29.748	<0.001	1.673	1.391	2.013
Constant	–6.729	1.044	41.505	<0.001	0.001	-	-

CI, confidence interval; DII, dietary inflammatory index.

ROC Curve Analysis

ROC analysis results showed that the area under the curve (AUC) of DII in predicting the recurrence of plaque psoriasis vulgaris was 0.815, and the standard error was 0.031 (95% confidence interval (CI): 0.754–0.877, $p < 0.001$), with a Youden's index of 0.60, sensitivity of 74.7%, and specificity of 84.8%. Among the variables tested, DII exhibited the highest predictive value marked by high specificity and sensitivity, as shown in Table 4 and Fig. 1.

Discussion

In this study, we conducted a retrospective analysis of clinical data from 200 patients who had recovered from plaque psoriasis to investigate the predictive value of DII for disease recurrence. Our results demonstrated that DII is one of the independent influencing factors, possessing high sensitivity and specificity in predicting the recurrence of plaque psoriasis. This finding not only reveals a close connection between diet and plaque psoriasis recurrence but also offers a new perspective on the prevention and management of plaque psoriasis.

Firstly, from a mechanistic perspective, the DII serves as a measure of the balance between pro-inflammatory and anti-inflammatory components in an individual's daily diet, reflecting the presence of proinflammatory and anti-inflammatory factors. A high DII indicates high levels of proinflammatory components such

Table 4. ROC analysis results.

Factor	AUC	Standard error	95% CI	Youden's index	Sensitivity	Specificity	*p*	Cut-off value
Sleep inadequacy	0.715	0.037	0.642–0.787	0.43	70.5	72.4	<0.001	-
Anxiety	0.687	0.039	0.612–0.763	0.13	81.1	31.4	<0.001	-
Smoking	0.590	0.040	0.511–0.669	0.17	48.4	69.5	0.029	-
Infections	0.605	0.040	0.526–0.684	0.22	30.5	91.5	0.010	-
DII	0.815	0.031	0.754–0.877	0.60	74.7	84.8	<0.001	1.02

AUC, area under the curve; CI, confidence interval; DII, dietary inflammatory index; ROC, receiver operating characteristic.

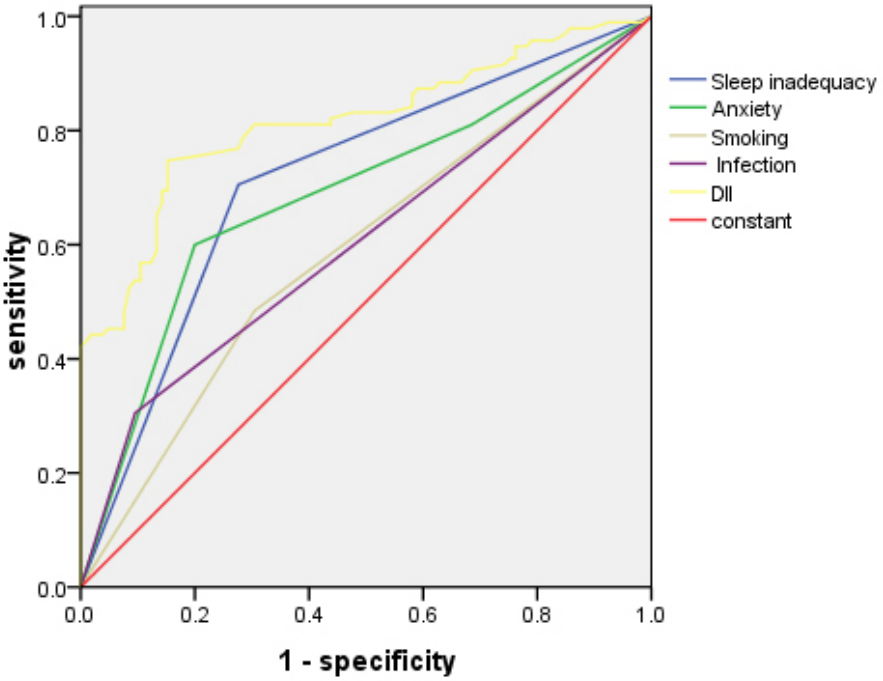

Fig. 1. ROC curve. The area under the predictive curve for DII is closest to 1, indicating the highest predictive value. DII, dietary inflammatory index.

as sugar, fat, processed foods, etc., and deficiency in anti-inflammatory components like dietary fiber, antioxidants, etc., in a diet (Mulligan et al, 2024; Pu et al, 2024). This imbalanced dietary structure may increase the risk of plaque psoriasis recurrence by impacting the body's immune response and inflammation regulatory mechanisms. Previous researches have shown that plaque psoriasis patients exhibit immune system abnormalities, particularly imbalances in T cell subpopulations and overexpression of inflammatory mediators, which are closely associated with the onset and recurrence of plaque psoriasis (Pürschel and Pahl, 1976; Qi and Gou, 2024a). The analysis suggests that this immune dysregulation may be influenced by various dietary components, such as saturated fatty acids, monosaccharides, red meat, and alcohol, which can exacerbate symptoms of plaque psoriasis by activating inflammatory pathways, including the Nucleotide-binding Oligomer-

ization Domain-like Receptors (NLR) Family, Pyrin Domain Containing Protein 3 (NLRP3) inflammasome, Tumor Necrosis Factor-α (TNF-α)/Interleukin-23 (IL-23)/Interleukin 17 (IL-17) pathways, reactive oxygen species and prostaglandins/leukotrienes, or by inhibiting regulatory T cell function. In contrast, nutrients like n-3 polyunsaturated fatty acids, vitamin D, vitamin B12, short-chain fatty acids, selenium, flavonoids, dietary fiber, and probiotics can improve symptoms of plaque psoriasis by inhibiting these inflammatory pathways or inducing the production of regulatory T cells. Furthermore, the expression of fatty acid-binding proteins (FABPs), particularly epidermal FABP (E-FABP), on keratinocytes and immune cells further highlights the critical role of lipid metabolism in immune regulation. High-fat diets can upregulate E-FABP expression and promote skin inflammation, while Cluster of Differentiation 8 Positive (CD8+) tissue-resident memory (TRM) cells rely on exogenous lipids in the skin as a source of energy for survival. T cells lacking FABP4 and FABP5 cannot uptake and utilize exogenous free fatty acids, leading to reduced long-term survival and impaired function of CD8+ TRM cells. These studies collectively emphasize the importance of dietary components and lipid metabolism in immune regulation in the context of plaque psoriasis. Therefore, adjusting dietary structure to reduce DII may improve the body's immune status, reduce the production of inflammatory factors, and consequently lower the risk of plaque psoriasis recurrence (Qi et al, 2024b). Additionally, researches have shown that TRM cells—a unique subset of memory T cells—play a central role in the recurrence of various autoimmune and infectious diseases by exhibiting long-term survival in specific tissues and high sensitivity and specificity to antigen re-stimulation. For instance, in vitiligo patients, abnormal activation and accumulation of TRM cells are considered significant drivers of disease recurrence. In the study of autoimmune diseases affecting organs like the liver, a close relationship has been observed between TRM cells and disease severity and recurrence risk (Ryan et al, 2021). Although dietary factors do not directly affect TRM cells, they can indirectly influence the development and function of TRM cells by regulating the overall immune status and nutritional status of the body. Malnutrition may lead to impaired immune cell function, including TRM cells, reducing their immune response capabilities and increasing the likelihood of disease recurrence (Shah et al, 2024). Conversely, a balanced diet and adequate nutrient intake help maintain normal immune cell function, providing strong support for reducing the risk of disease recurrence.

This study further confirmed through multivariate logistic regression analysis that sleep inadequacy, anxiety, smoking, and infections are independent risk factors for the recurrence of plaque psoriasis. The reasons for this may be as follows: firstly, the impact of sleep inadequacy and anxiety on plaque psoriasis recurrence may stem from their negative regulation of the immune system. Prolonged sleep deprivation can disrupt the body's circadian rhythm, affecting the normal function and distribution of immune cells, thereby reducing the body's immunity (Wang et al, 2024). Additionally, anxiety and depression can also disrupt the balance between inflammatory factors and immune responses through the neuroendocrine-immune axis, increasing the risk of plaque psoriasis recurrence. These interactions between

psychological and physiological factors make sleep inadequacy and anxiety important triggers for plaque psoriasis recurrence (You et al, 2024). Secondly, smoking, as an independent risk factor for plaque psoriasis, may instigate direct damage to the skin through harmful substances in tobacco and indirectly promote disease progression by weakening the immune system. Smoking can impair the skin barrier function, increase the penetration and irritation of harmful substances to the skin, and components like nicotine in tobacco may also affect the activation and differentiation of T cells, promote the production of inflammatory factors, exacerbate plaque psoriasis symptoms, and contribute to recurrence (Zhang et al, 2024; Zhao et al, 2024). Finally, infection, as one of the important triggering factors for plaque psoriasis recurrence, may be associated with the release of inflammatory factors and activation of immune cells during the infection process. Infection can lead to an excessive immune response in the body, producing a large number of inflammatory factors such as IL-6 and TNF-α, which not only participate in the clearance of infection but may also activate immune responses related to plaque psoriasis, leading to worsening skin lesions and recurrence (Zheng et al, 2024). Moreover, infections may also provide favorable conditions for plaque psoriasis recurrence by disrupting the skin barrier function, promoting the colonization and reproduction of pathogens (Zhu et al, 2024). These publishing findings lend credence to our results that sleep inadequacy, anxiety, smoking, and infections are independent risk factors for the recurrence of plaque psoriasis because they negatively impact the body's immune system, skin barrier function, and inflammatory responses through different pathways and mechanisms, thereby increasing the relevant risk. Therefore, in the prevention and management of plaque psoriasis, it is also necessary to comprehensively consider patients' psychological status, lifestyle habits, and other factors, in addition to dietary factors, to formulate overarching intervention measures to reduce the risk of recurrence.

The AUC is a measure of the overall performance of diagnostic tests, a comprehensive measure of sensitivity and specificity, and it is the criterion for judging the overall value of an indicator when there is a dispute over the sensitivity and specificity (Park et al, 2004). The ROC analysis results show that the DII boasts high sensitivity and specificity in predicting the recurrence of plaque psoriasis vulgaris, with an AUC of 0.815, indicating that DII is an effective predictive indicator.

Despite the meaningful findings of this study, several limitations should be acknowledged. Firstly, this study is retrospective and may be subject to selection bias and recall bias. Future research could consider using prospective designs or randomized controlled trials to further validate the predictive value of DII. Secondly, the sample size of this study is relatively small and all data were derived from a single medical institution, potentially limiting the generalizability of the results obtained. Future studies could utilize larger samples with data gathered from multiple centers to enhance the reliability and representativeness of the results. In addition, this study mainly focused on the relationship between DII and plaque psoriasis recurrence but did not fully explore potential confounding variables that may affect recurrence, such as drug use, physical activity levels, and comorbidities. These factors may also have an impact on the study results but did not receive the

attention and in-depth analysis they deserve. Thus, these potential confounders can be further explored in future research.

Conclusion

Through a retrospective analysis and an in-depth investigation of its complex relationship with other influencing factors, this study revealed that the DII can predict the recurrence of plaque psoriasis, offering not only new insights and approaches for the prevention and management of this pathological condition but also important references and guidance for future research.

Key Points

- This study explores the predictive value of DII in plaque psoriasis recurrence, offering new insights for disease prediction and prevention.
- Dietary inflammatory index (DII) has high specificity and sensitivity in predicting plaque psoriasis recurrence, aiding in enhancing treatment precision.
- Our study showed that patients with lower DII had significantly better follow-up outcomes, with half of them not experiencing recurrence.
- Lowering DII through diet may reduce the risk of plaque psoriasis recurrence, offering a new treatment strategy of high clinical significance.

Availability of Data and Materials

All data included in this study are available from the corresponding author upon reasonable request.

Author Contributions

ZG and XZ conceived and designed the study. ZG collected and analysed the data. ZG drafted the manuscript. XZ supervised the work and revised the manuscript critically for important intellectual content. Both authors approved the final version. Both authors agreed to be accountable for all aspects of the work to ensure that questions about the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Ethics Approval and Consent to Participate

This study was conducted according to the principles expressed in the Declaration of Helsinki and approved by China-Japan Friendship Hospital Clinical Research Ethics Committee (Approval Number: 2022-KY-224). Those who accepted to participate gave their consent either verbally or signed the informed consent form.

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Conflict of Interest

The authors declare no conflict of interest.

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