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ORIGINAL RESEARCH

Seasonal Variation of Psoriasis and Its Impact in the Therapeutic Management: A Retrospective Study on Chinese Patients

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Background: The seasonal patterns of psoriasis have been observed in previous studies. However, no published data indicated the risk factors associated with the seasonal variation.
Purpose: This study aimed to investigate potentially related factors associated with seasonal pattern of psoriasis and provide possible implications for alleviating psoriasis in clinical practice.
Patients and Methods: The retrospective study was conducted in Chinese patients with psoriasis. Demographic and clinical information were collected. Multivariable logistic regression analyses (calculating adjusted odds ratios [AORs]) were used to analyze data.
Results: We continually enrolled 2270 patients (1496 males and 774 females) with psoriasis based on inclusion criteria. Disease duration (AOR=1.06, 95% CI: 1.05–1.07), hyperlipidemia (AOR=1.77, 95% CI: 1.06–2.98) and smoking (AOR=1.40, 95% CI: 1.17–1.68) were significantly associated with severe psoriasis in autumn/winter. Age (AOR=0.98, 95% CI:0.97–0.99) and occupations with more sunlight exposure (AOR=0.78, 95% CI: 0.61–0.99) were negatively associated with the seasonal aggravation. Subgroup analysis showed that occupations with more sunlight exposure (AOR=0.64, 95% CI: 0.43–0.94) were protective factors only in late-onset psoriasis but not early-onset, while smoking (AOR=1.39, 95% CI: 1.11–1.74) was risk factor in the early-onset psoriasis.
Conclusion: Psoriatic patients who had occupation with more sunlight exposure were less likely to report aggravation of psoriasis in autumn/winter. On the contrary, smoking and hyperlipidemia were positively associated with the seasonal aggravation. Additional prospective study is needed to identify the causality.

Keywords: psoriasis, seasonal variation, weather, occupational exposure, ultraviolet, smoking

Introduction

Psoriasis is an auto-inflammatory skin disease characterized by red or silver scaly plaques, typically distributing the elbows, knees, and scalp. The prevalence of psoriasis ranges from 0.09% to 11.4% globally,[1,2] the prevalence is between 0.17% and 0.59% in China.[3,4] Though the pathophysiology of psoriasis remains unclarified, it is identified that psoriasis can be induced by genetic and environmental factors.[5,6] It is known that infections,[6] psychological stress,[6] diet,[6,7] medication,[6,7] smoking,[6–10] alcohol drinking,[6,9,11] so as the cold and dry weather,[12] could trigger the flare-ups of psoriasis. Systemic inflammation together with demographics[13] could drastically influence the prescription of treatment and therapeutic response by increasing psoriasis-related

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comorbidities burden (ie, cardiovascular,[14] respiratory[15] or hepatic disease[16]). Previous studies confirmed that psoriasis conditions vary with the season, and severe psoriasis were more likely to happen in cold season, such as autumn or/and winter.[12] The seasonal patterns of psoriasis have been commonly observed in clinical practice. Many studies with different designs have investigated the seasonality of psoriasis.[12,17–20] However, to our knowledge, no published research has investigated the risk factors associated with the seasonal variation.

Therefore, the purpose of the study is to investigate the seasonal variation of psoriasis conditions and its potential related factors in Chinese patients with psoriasis, and provide possible implications for alleviating psoriasis in clinical practice.

Patients and Methods

Study Design and Participants

This was a single center retrospective study in Chinese patients with psoriasis. Patients initially admitted to the dermatology department of Xiangya Hospital from Jan 2016 to Sep 2019 were consecutively enrolled if they met all the following inclusion criteria: 1) age ≥18 years; 2) diagnosis of plaque psoriasis was confirmed by two or more experienced dermatologists; 3) disease duration ≥ 1 year. Cases with missing data (including demographic and clinical information) were excluded from the study. All participants signed the consent form and were informed about the purpose of the study. The study followed the Declaration of Helsinki and was approved by the institutional research ethics boards of Xiangya Hospital.

Data Collection

Information included demographic characteristics (age, sex, education level, occupation, cigarette smoking and alcohol drinking) and clinical characteristics (psoriasis-related information and comorbidities) were collected through face-to-face interview. Deterioration of psoriasis condition was the primary outcome of the study, measured by the Global Rating of Change (GRC). We defined deteriorated psoriasis condition as the increased erythema, infiltration, desquamation, and symptom of itching. Comorbidities were determined by laboratory tests, self-report and medications usage. Hyperlipidemia was diagnosed according to triglycerides ≥2.3 mmol/L, low-density lipoprotein cholesterol≥4.1 mmol/L, high-density lipoprotein cholesterol ≤1.0mmol/L or total cholesterol ≥6.2mmol/L based on the Chinese Guideline for the Management of Hyperlipidemia in Adults in 2016.[21] Hypertension was diagnosed according to self-report and the Chinese Guidelines for the Management of Hypertension.[22] Diabetes was diagnosed according to self-report and the 1999 WHO diagnostic criteria. Height, weight, waistline and hipline were measured in a standard way. Body Mass Index (BMI) was calculated as weight (kg)/height squared (m2). Waist-to-Height Ratio (WHR) was calculated as waistline (cm)/hipline (cm). Occupations were grouped by reviewing of job descriptions into categories of occupations with more sunlight exposure or not. Participants who engaged in agriculture, forestry, stockbreeding, aquaculture or construction were defined as individuals with more sunlight exposure. Participants who work indoor, or being a full-time student or retired were defined as individuals with less sunlight exposure. We categorized patients who developed psoriatic lesions prior to 40 years old as the early onset group, and after 40 as the late onset one.

Statistical Analysis

Continuous variables with normal distribution were expressed as mean ± standard deviation (SD), and compared with analysis of variance (ANOVA). Continuous data with skewed distribution were presented as median (interquartile range, IQR), and compared with Mann–Whitney rank sum test. Categorical variables were summarized as counts (percentages) and compared using the chi-square test or Fisher's exact test. Multivariable logistic regression analyses were employed to analyze the data. Variables having P value <0.1 on the univariate analysis were included in multivariable analysis. Odds ratio (OR) and 95% confidence interval were used to present the effect size of the associations. P value less than 0.05 was considered statistically significant. The data were analyzed with SPSS 23 (IBM, SPSS Statistics 23).

Results

This study included 2582 patients under the inclusion criteria. Three hundred and twelve cases were excluded for incomplete data. Table 1 summarized the demographic and clinical characteristics of 2270 participants (1496 males and 774 females) divided into two groups according to whether the patients have aggravated psoriasis conditions during autumn or winter. A total of 53.2% reported the seasonal pattern of disease. The mean age of all participants was 42.1±14.1 years, and the mean disease

Table 1 Characteristics of the Patients by Different Psoriasis Condition in Winter/Autumn

Characteristics	Psoriasis Aggravated in Winter/Autumn		
	Yes (n=1207)	No (n=1063)	*P*
Age (mean ± SD)	41.2±13.3	43.3±14.8	0.001
Female, n (%)	410 (34.0)	365 (34.3)	0.854
Education level, n (%)			0.007
Primary	128 (10.6)	149 (14.0)	
Secondary	615 (50.9)	561 (52.8)	
Higher	464 (38.5)	353 (33.2)	
Age at onset (mean ± SD)	29.6±12.8	35.1±14.9	<0.001
Disease duration (mean ± SD)	11.5±8.9	8.2±8.3	<0.001
BMI (kg/m^2) (mean ± SD)	23.5±3.6	23.9±3.8	0.009
WHR (mean ± SD)	0.89±0.07	0.90±0.08	0.137
Occupation with more sunlight exposure	193 (16.0)	217 (20.4)	0.006
Comorbidities, n (%)			
Hypertension	87 (7.2)	99 (9.3)	0.068
Hyperlipidemia	44 (3.6)	27 (2.5)	0.131
Diabetes	55 (4.6)	51 (4.8)	0.786
Smoking	447 (37.0)	354 (33.3)	0.063
Alcohol drinking	412 (34.1)	389 (36.6)	0.231

Note: *P* value by univariate logistic regression model.
Abbreviations: BMI, body mass index; WHR, waist-to-height ratio.

duration was 10.0±8.8 years. Age, educational level, disease duration, BMI, smoking and occupations with more sunlight exposure were significantly different between the two groups ($P<0.05$). No obvious differences were found in sex, WHR, comorbidities (hypertension, hyperlipidemia and diabetes) and alcohol drinking ($P>0.05$).

To further examine the associations, we performed a series of logistic regression modeling with adjustments. As shown in Table 2, age (AOR=0.98; 95% CI: 0.97–0.99; $P<0.001$) and occupation with more sunlight exposure (AOR=0.78; 95% CI: 0.61–0.99; $P=0.039$) were negatively associated with severe symptoms in autumn or winter. Disease duration (AOR=1.06; 95% CI: 1.05–1.07; $P<0.001$), hyperlipidemia (AOR=1.77; 95% CI: 1.06–2.98; $P=0.030$) and smoking (AOR=1.40; 95% CI: 1.17–1.68; $P<0.001$) were positively associated with the aggravation of psoriasis in winter.

Subgroup analyses for both early and late-onset psoriasis were shown in Table 3. The association remained consistent in general. Smoking was positively associated with psoriasis aggravation in autumn/winter for early-onset psoriasis (AOR=1.39; 95% CI: 1.11–1.74; $P=0.004$), age (AOR=0.97; 95% CI: 0.95–0.99; $P=0.009$) and occupation with more sunlight exposure (AOR=0.64; 95% CI: 0.43–0.94; $P=0.024$) were negatively associated with aggravated conditions in autumn/winter for late-onset type of psoriasis.

Discussion

Our study indicated that 53.2% patients with psoriasis had aggravation of disease conditions in fall/winter. The seasonality peaking of psoriasis has been observed in clinical practice, which is verified by the significant seasonal variation in dermatologic office visits.[12] Observational investigations, based on Google Trends datasets, showed that the public interest in seeking psoriasis-related information displayed a seasonal trend, with the highest interest appeared in late winter and early spring.[17,18] The trend of online researches also implied the association between the psoriasis flare and the weather.

Low humidity and lack of ultraviolet (UV) radiation exposure were mainly blamed for the aggravation of the psoriasis in fall/winter.[19,20] It has been known for centuries that sunlight can improve many inflammatory skin conditions, including psoriasis. UV radiation has been generally used in treating psoriasis for decades. Wide variation in the prevalence of psoriasis among populations could be attributed to the regional disparity of UV exposure.[23] Low temperature makes heavy clothing necessary, thus leading to the deficiency of UV exposure. The mechanisms of UV in clearing psoriasis as follows. First, UV radiation is the main source of cutaneous vitamin D production. Significant associations between the low serum vitamin D level and psoriasis were found.[24] Low level of vitamin D cannot prevent skin lesions from inhibiting the proliferation and inducing differentiation of keratinocyte.[25,26] Second, UV suppresses the immune response by inhibiting Th17/IL-23 axis[27,28] and type 1 T-cell pathway,[29–31] inducing T-cell apoptosis,[32,33] followed by normalization of epidermal hyperplasia in vivo.[34,35] In addition, UV contributes to apoptosis in lesional epidermis, especially the keratinocytes.[36,37] Though the improvement of skin lesions was mainly related to sun exposure, the majority of psoriasis cases reported relief in summer and exacerbation in winter, few presented worse conditions due to photosensitivity.[19] The relationship between skin and UV is complexed. Photoadaptation is a protective

Table 2 Comparison of Both Psoriasis Condition in Winter/Autumn

Item	Psoriasis Aggravated in Winter/Autumn			
	No	Yes		
	OR	OR (95% CI)	AOR (95% CI) [a]	*P*
Age	1	0.99 (0.98, 0.99)	0.98 (0.97, 0.99)	<0.001
Female	1	0.98 (0.83, 1.17)	0.93 (0.75, 1.16)	0.516
Disease duration	1	1.05 (1.04, 1.06)	1.06 (1.05, 1.07)	<0.001
BMI (kg/m^2)	1	0.97 (0.95, 0.99)	0.98 (0.96, 1.00)	0.127
Occupation with more sunlight exposure	1	0.74 (0.60, 0.92)	0.78 (0.61, 0.99)	0.039
Comorbidities				
Hypertension	1	0.76 (0.56, 1.02)	0.90 (0.64, 1.26)	0.536
Hyperlipidemia	1	1.45 (0.89, 2.36)	1.77 (1.06, 2.98)	0.030
Diabetes	1	0.95 (0.64, 1.40)	1.18 (0.77, 1.81)	0.461
Smoking	1	1.18 (0.99, 1.40)	1.40 (1.17, 1.68)	<0.001
Alcohol drinking	1	0.90 (0.76, 1.07)	0.93 (0.76, 1.12)	0.426

Notes: [a]Adjusted for age, educational level, disease duration, BMI and smoking. *P* value for adjusted OR, estimated from multivariable logistic regression model.
Abbreviations: OR, unadjusted odds ratio; AOR, adjusted odds ratio; CI, confidence interval; BMI, body mass index.

mechanism that the skin damage of the response to exposure to UV reduces after repeated exposures, which was verified in phototherapy for psoriasis.[38] The melatonin, a hormone connected with light (seasonality and circadian rhythm), was found to have utility of maintaining skin homeostasis by suppressing of UV-induced photodamage.[39] Exposure to low humidity and low temperature could cause skin hydration decreasing.[40,41] The seasonal variation of skin hydration was also confirmed by Raman spectra in healthy skin.[42] Low environmental humidity causes the impairment of the skin

Table 3 Subgroup Analyses by Both Early and Late-Onset Psoriasis

Variables	Early-Onset Psoriasis		Late-Onset Psoriasis	
	AOR (95% CI) [a]	*P*	AOR (95% CI) [a]	*P*
Age	0.99 (0.97, 1.00)	0.107	0.97 (0.95, 0.99)	0.009
Female	0.95 (0.73, 1.23)	0.696	0.91 (0.59, 1.41)	0.682
Disease duration	1.06 (1.04, 1.07)	<0.001	1.08 (1.05, 1.12)	<0.001
BMI (kg/m^2)	0.98 (0.95, 1.00)	0.099	0.99 (0.94, 1.03)	0.557
Occupation with more sunlight exposure	0.88 (0.64, 1.20)	0.403	0.64 (0.43, 0.94)	0.024
Comorbidities				
Hypertension	1.06 (0.62, 1.79)	0.841	0.80 (0.50, 1.28)	0.351
Hyperlipidemia	1.70 (0.78, 3.68)	0.182	1.79 (0.88, 3.64)	0.109
Diabetes	1.16 (0.55, 2.48)	0.697	1.18 (0.69, 2.01)	0.541
Smoking	1.39 (1.11, 1.74)	0.004	1.34 (0.96, 1.86)	0.087
Alcohol drinking	0.87 (0.69, 1.10)	0.243	1.01 (0.71, 1.42)	0.965

Notes: [a]Adjusted for age, educational level, disease duration, BMI and smoking. *P* value for adjusted OR, estimated from multivariable logistic regression model.
Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; BMI, body mass index.

barrier function and the increased susceptibility towards mechanical stress, resulting in marked epidermal hyperplasia.[43] However, the damp environment is also confirmed as the risk factor in the aggravation of psoriasis.[7] The ideal humidity level in patients with psoriasis remains unknown.

Actually, not all patients had the seasonal patterns of psoriasis. Our data showed 46.8% patients did not report the aggravation of psoriasis in autumn/winter. We explored the seasonal variation of psoriasis and its potential risk factors for the first time. Occupations with more sunlight exposure seemed to be the protective factor to psoriasis aggravation in cold weather, especially for late-onset psoriasis, which could be explained as the sun exposure during the cold and dry seasons alleviates the skin conditions. In view of the efficacy of ultraviolet irradiation on psoriatic lesions, phototherapy and climatotherapy (such as Dead Sea climatotherapy) are generally used as therapies for psoriasis. However, the further study between the natural UV exposure and disease severity in psoriasis is warranted.

Pascoe and Kimball estimated the seasonal variation in psoriasis by using Physician's Global Assessment (PGA) scales and disease clearing level.[20] Different from the study, our data showed that age showed a negative relationship with the seasonal aggravation, contrary to disease duration. Different evaluations of disease severity make the difference, on account of the discordance between objective measurement and patient self-report.[44] Still, the non-sampling error cannot be avoided if the study based on patient-reported outcomes.

Smoking,[6–10] alcohol consumption[6,9,10] and metabolic syndrome[9,45] (obesity, hypertension, hyperlipidemia, diabetes) are recognized as risk factors for severe psoriasis. Our study had similar results, and smoking showed bigger effects on disease conditions for early-onset psoriasis in fall/winter. The positive association of smoking, hyperlipidemia with psoriasis aggravation emphasizes the significance of lifestyle interventions in psoriasis treatment. Smoking cessation and diet management should be strongly recommended by physicians. To control the disease activity and itching symptom, the necessity of long-term therapy needs to be emphasized since seasonality and circadian rhythm perturbations deeply influence psoriasis severity and flare-ups.[46,47]

This study has some limitations. First, all data were collected from a single center, causal inferences need to be discriminate by prospective studies. Second, a part of variables was collected based on patient self-reports, which leads to inevitable response bias and recall bias. Third, in our data analysis, major potential confounders have been controlled, however, the unknown and unmeasured factors cannot be adjusted.

Conclusions

In conclusion, our study indicated that occupations with more sunlight exposure might prevent patients from aggravation of psoriasis in the cold and dry season. In contrast, smoking and hyperlipidemia were positively associated with the seasonal aggravation. Causality has to be identified by prospective studies. Lifestyle changes, such as appropriate natural UV exposure through outdoor activities and smoking cessation, are essential for alleviating psoriasis.

Data Sharing Statement

The data used in this study is unpublished, but it can be obtained through contacting first authors' emails (Qiaolin Wang, email: wangqiaolin701@163.com).

Ethics Approval

This study was approved by the institutional research ethics boards of Xiangya Hospital, Central South University (Changsha, China).

Consent for Publication

All authors have agreed to submit this article to the journal and to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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