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Research Article

The Characteristics of COVID-19 Symptoms and Skin Manifestations among Nonhospitalized COVID-19 Patients with Psoriasis during the Omicron Pandemic in China: A Single-Center Survey-Based Study

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Background. The global impact of coronavirus 2019 (COVID-19) has raised concerns about the management of psoriasis patients, especially among those using biologics. *Methods*. We conducted a survey-based research among Omicron-infected (confirmed, probable, and suspected ones) psoriasis patients in the department of dermatology, West China Hospital, Sichuan University, from January 9th to January 22nd, 2023. We collected demographic and clinical information (psoriasis- and COVID-19-related) and conducted statistics analysis. *Results*. Of the 240 patients enrolled, they were classified by the psoriatic treatment, as biologics ($n = 138$), nonbiological systematic treatment ($n = 52$), and topical treatment or without pharmacological treatment ($n = 50$). This study showed the characteristics of Omicron-related symptoms and cutaneous signs in patients. We observed that patients who received topical treatment or without pharmacological treatment had a lower risk of presenting with COVID-19 symptoms in the fully adjusted logistic model (OR = 0.40, 95% CI: 0.18–0.90, and $P = 0.025$). Moreover, in the model for skin manifestations, nonbiological systematic treatment (OR = 2.15, 95% CI: 1.08–4.27, and $P = 0.029$) and high BMI (OR = 1.10, 95% CI: 1.00–1.20, and $P = 0.042$) were correlative factors. *Conclusions*. Our data suggested that differential psoriatic treatment might be a correlative factor in developing symptomatic or asymptomatic Omicron infection and presenting cutaneous signs.

1. Introduction

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has severely affected the whole world. During the coronavirus 2019 (COVID-19) community pandemic, the management of psoriasis, a chronic immune-related disease, particularly those patients who received biologics, has raised concerns among dermatologists [1]. At the early stage, the key concern was whether patients who received biologics were more susceptible to COVID-19 [2]. On the one hand, previous research indicated that psoriasis might have increased subclinical airway inflammation [3]; on the other hand, the biologics-associated immunosuppressive effect and common upper respiratory tract infection were also worrisome [4]. However, accumulating evidence has shown that immunosuppressive biologics did not increase the risk of COVID-19 infection and its related hospitalization [1, 5–7], and the guidance from the national psoriasis foundation (NPF) recommended that psoriasis patients without current COVID-19 infection should continue biological therapy [8].

In addition, the SARS-CoV-2 mutates in the direction of lower virulence and higher infectious and the COVID-19 infection is spreading wider [9]. Thus, the primary concerns are the prevalence of COVID-19-related symptoms and skin manifestations in psoriasis patients. Previous studies have

presented that more than one-fifth of psoriasis patients who received biologics suffered psoriasis worsening mainly because of the treatment discontinuation, while a few participants were confirmed to be affected with COVID-19 [10, 11]. The shreds of evidence on the direct impact of COVID-19 infection on psoriasis patients who received biologics were limited. Since December 2022, the COVID-19 zero policy has been relaxed in China and then, the cases of Omicron variant (BA.5.2 and BF.7) infection grew dramatically rapid due to the robust transmission in a short period.

In this study, we aim to profile the characteristics of COVID-19-related symptoms and cutaneous signs among psoriasis patients who received different therapeutic regimes during the early high epidemic period of the Omicron variant.

2. Patients and Methods

We conducted this survey-based research from January 9th to January 22nd, 2023, during the first phase of the Omicron pandemic. Participants were psoriasis patients in our cohort, named PSOWCH (psoriasis cohort of West China Hospital). Patients were informed of the purpose of this study and agreed to the patient's consent. Then, the questionnaires were transferred to them through smartphones and completed with the doctors' guidance to help explain the questions but avoid influencing their choices. This questionnaire contains demographic information, pertinent epidemiologic information about COVID-19 (patients and their cohabitants), comorbidities associated with the risk for relatively severe COVID-19 [12], COVID-19-related symptoms [13], and cutaneous signs (within two weeks after the COVID-19 infection). The establishment of PSOWCH and the information permission were under the Helsinki Declaration of 1964 (revision in 2013) and approved by the Biomedical Research Ethics Committee of West China Hospital of Sichuan University (approval number: 2021-581).

In total, we collected 269 valid questionnaires from PSOWCH, and the patients were enrolled if they were (1) aged ≥ 18 years old and (2) with a confirmed diagnosis of psoriasis. Patients were excluded if they were asymptomatic without epidemiological history and did not complete the COVID-19 test. According to the COVID-19 case definition published by the WHO (version 2022) [14], COVID-19 cases are classified as confirmed, probable, and suspected SARS-CoV-2 cases based on the COVID-19 tests (nucleic acid amplification test or the SARS-CoV-2 antigen-rapid diagnostic test), clinical characteristics, and epidemiological criteria, and the specific number of the three classes are shown in Figure 1. Eventually, we included 240 patients in this study and then, they were subdivided into three groups based on their therapeutic regimes as follows: biologics (BIO), containing adalimumab (ADA), secukinumab (SEC), ixekizumab (IXE), and ustekinumab (UST), nonbiological systematic treatment (NBT), and topical treatment or without any pharmacotherapy (TT).

The statistical analysis was completed through GraphPad Prism 9.0 and SPSS Statistics version 26.0. Proper descriptive methods were used, as the categorical variables were presented as the count (percentage) and continuous variables were presented as the mean (standard deviation, SD). The differences in the variables among multiple subgroups were managed using Pearson's χ^2 test (or Fisher's exact test) or the Kruskal–Wallis test (or one-way ANOVA test). The multivariable and bivariable logistic regression models were used to adjust for predefined confounders and further analyze whether the difference in therapeutic regimes is associated with the incidence of COVID-19 symptoms and cutaneous signs. In the multivariable logistic regression models, we could only include ten variables at most, as the number of participants in the smallest subgroup should be at least five times greater than the number of included variables. Thus, we conducted the univariate analysis to screen out comorbidity variables with significant differences and then included them in the models. A P value < 0.05 was considered significant.

3. Results

This study enrolled 240 patients (female/male: 92/148), among which 138 patients (female/male: 52/86) were in the BIO group, 52 patients (female/male: 19/33) were in the NBT group, and the remaining 50 patients (female/male: 21/29) only used topical medications or even with nonpharmacologic treatment were included in the TT group. In the BIO group, patients were either receiving ADA (14, 10.15%), SEC (65, 47.10%), IXE (22, 15.94%), or UST (37, 26.81%). The NBT group covered patients who received methotrexate (26, 50.00%), acitretin (5, 9.61%), traditional Chinese medicine (19, 36.54%), or phototherapy (2, 3.85%) (Table 1).

The mean age of patients in these three subgroups was 43.06 (SD: 12.51), 38.48 (SD: 11.81), and 37 (SD: 11.01) years old, with a significant difference (P = 0.012). Regarding the smoking status, there were 55 (39.86%), 17 (32.69%), and 19 (38.00%) smokers (current smokers and ex-smokers) in BIO, NBT, and TT groups, respectively. The comorbidities were almost evenly distributed, while the prevalence of hypertension (22, 15.94%) was higher in the BIO group with a statistical significance (P = 0.003). In addition, 33 patients (23.91%) in the BIO group did not take the COVID-19 vaccine, which is significantly more than in the other two groups (P = 0.005). Other baseline and clinical characteristics showed no statistical difference among these three groups and are detailed in Table 1.

Concerning the COVID-19-related symptoms, 186 patients (77.50%, n = 240) presented with more than one sign, and among which 138 (74.19%, n = 186) patients reported that the COVID-19 symptom duration was less than a week. Fever (141, 75.81%, n = 186), cough (124, 66.67%, n = 186), and fatigue (103, 55.37%, n = 186) were the top three common ones, with the same ranking in the three subgroups. In addition, we focused on dyspnea, a debilitating symptom distinct from the signs and symptoms of mild COVID-19. Out of 24 patients (12.90%, n = 186) who

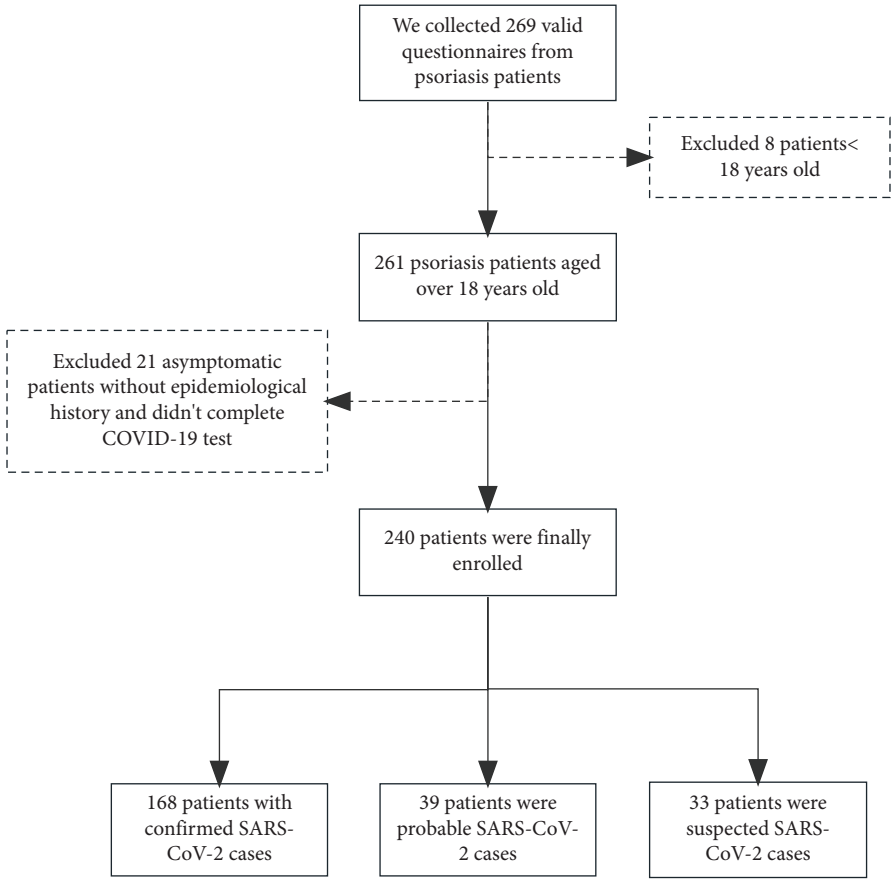

Figure 1: The flowchart for enrolment in this study.

presented with dyspnea, 13 (11.50%, $n = 113$) of them were in the BIO group, 8 patients (20.51%, $n = 39$) were in the NBT group, and 3 patients (8.82%, $n = 34$) in the TT groups. There was no significant difference in the prevalence of each symptom in the BIO, NBT, and TT groups (Table 2).

In order to attenuate the effect of confounders predefined, logistic regression models were built, focusing on the presence of symptoms of COVID-19. The minimally adjusted model involved gender, age, and BMI as confounders. The minimally adjusted OR of the group TT was 0.41 (95% CI: 0.19–0.89). The fully adjusted model included gender, age, BMI, the comorbidity of hypertension, ever smoked, and vaccination status (received or not), and the adjusted OR of the group TT was 0.40 (95% CI: 0.18–0.90). Both models indicated that the group TT has a lower risk of presenting with COVID-19 symptoms (Table 3). Then, further exploration in the existence of dyspnea was conducted. Given the sample size limitation, we proceeded with a series of bivariate logistic regression to adjust the confounders, which showed no more risk of presenting dyspnea in the groups BIO and NBT (Table 4).

Intriguingly, we also explored the relationship between skin manifestations of psoriasis and the Omicron variant. 83 out of 240 (34.58%) patients had one or one more psoriatic sign in 2 weeks after infection, involving 60 patients (25.00%) who developed new lesions, 33 patients (13.75%) reported aggravating pruritus, and 29 patients (12.08%) had severe desquamation (Table 2). Multivariate logistic regression was performed to adjust the confounders, and we observed that patients with higher BMI (adjusted OR = 1.10, 95% CI = 1.00–1.20) and who received NBT (adjusted OR = 2.15, 95% CI = 1.08–4.27) had a relatively high risk of developing cutaneous signs after COVID-19 infection in the fully adjusted model (Table 5). In the supplementary file 1, we profiled the PASI changes of 33 patients (24 of them in the BIO, 7 patients in the NBT, and 2 patients in the TT group).

4. Discussion

This survey-based study profiled the characteristics of COVID-19 symptoms and the skin manifestations among 240 nonhospitalized COVID-19 patients (including confirmed, probable, and suspected ones) with psoriasis in the Omicron outbreak in China. Moreover, our data showed that differential psoriatic treatment might be a correlative factor in developing symptomatic or asymptomatic Omicron infection and presenting cutaneous signs after infection.

In this study, 74.19% of the COVID-19 symptomatic patients ($n = 186$) reported that the symptom duration was within a week, consistent with the mean duration of 6.87 days in Omicron dominance presented by a prospective observational study in the UK [15]. Regarding the common

Table 1: The baseline characteristics of the participants.

Variables	Total ($n = 240$)	BIO ($n = 138$)	NBT ($n = 52$)	TT ($n = 50$)	P value
Age, years, mean (SD)	40.08 (12.30)	43.06 (12.51)	38.48 (11.81)	37.00 (11.01)	**0.012**
Gender, M, counts (%)	148 (61.67)	86 (62.32)	33 (63.46)	29 (58.00)	0.83
BMI[†], mean (SD)	23.47 (3.60)	23.91 (3.91)	23.43 (3.16)	22.3 (2.85)	0.088
BMI < 23, counts (%)	125 (52.08)	77 (55.80)	27 (51.92)	21 (42.00)	0.25
BMI ≥ 23, counts (%)	115 (47.92)	61 (44.20)	25 (48.08)	29 (58.00)	
Smoking					
Current smokers and ex-smokers, counts (%)	91 (37.92)	55 (39.86)	17 (32.69)	19 (38.00)	0.66
Never smoke, counts (%)	149 (62.08)	83 (60.14)	35 (67.31)	31 (62.00)	
Comorbidities					
Hypertension, counts (%)	25 (10.42)	22 (15.94)	3 (5.77)	0 (0.00)	**0.003**
Diabetes, counts (%)	11 (4.58)	7 (5.07)	1 (1.92)	3 (6.00)	0.53
Hyperlipidemia, counts (%)	11 (4.58)	8 (5.80)	0 (0.00)	3 (6.00)	0.22
COPD, counts (%)	6 (2.50)	3 (2.17)	1 (1.92)	2 (3.85)	0.74
CVD, counts (%)	6 (2.50)	5 (3.62)	1 (1.92)	0 (0.00)	0.63
CKD, counts (%)	2 (0.83)	1 (0.72)	1 (1.92)	0 (0.00)	0.67
Other IMDs, counts (%)	9 (3.75)	6 (4.35)	1 (1.92)	2 (3.85)	0.81
The doses of COVID-19 vaccination					
Completed vaccination, counts (%)	199 (82.92)	105 (76.09)	48 (92.31)	46 (92.00)	**0.005**
Not completed, counts (%)	41 (17.08)	33 (23.91)	4 (7.69)	4 (8.00)	
Therapy					
BIO, counts (%)					
ADA[‡], counts (%)	—	14 (10.15)	—	—	—
SEC, counts (%)	—	65 (47.10)	—	—	—
IXE, counts (%)	—	22 (15.94)	—	—	—
UST, counts (%)	—	37 (26.81)	-COVID	—	—
NBT, counts (%)					
MTX, counts (%)	—	—	26 (50.00)	—	—
Acitretin, counts (%)	—	—	5 (9.61)	—	—
TCM, counts (%)	—	—	19 (36.54)	—	—
Phototherapy, counts (%)	—	—	2 (3.85)	—	—
COVID status, counts (%)					
Confirmed cases, counts (%)	168 (70.00)	92 (66.67)	36 (69.23)	40 (80.00)	0.21
Probable cases, counts (%)	39 (16.25)	27 (19.56)	7 (13.46)	5 (10.00)	0.24
Suspected cases, counts (%)	33 (13.75)	19 (13.77)	9 (17.31)	5 (10.00)	0.56

Continuous variables are performed as the mean (SD) and categorical variables, as count (%). Accurate statistics are chosen for the data, including one-way analysis of variance (ANOVA), Kruskal–Wallis test, and Pearson's χ^2 test (or Fisher's exact test). A P value <0.05 is considered significant and marked into bold. [†]According to the recommendation of Asians' BMI classification, overweight is defined as $23 \leq \text{BMI} < 27.5$ and general obesity is defined as $27.5 \leq \text{BMI} < 32.5$ and the patients were stratified as BMI < 23 and BMI ≥ 23. [‡]The subgroup of ADA contains the original adalimumab and its biosimilars. Abbreviations: ADA: adalimumab, BMI: body mass index, BIO: biologics, CKD: chronic kidney disease, COPD: chronic obstructive pulmonary disease, CVD: cardiovascular disease, IXE: ixekizumab, M: male, NBT: nonbiological treatment. MTX: methotrexate, SEC: secukinumab, TCM: traditional Chinese medicine, TNF: tumor necrosis factor, TT: topical treatment or without pharmacological therapy, and UST: ustekinumab.

symptoms, we reported that the top three were fever, fatigue, and cough. However, it is different from previous knowledge about the distribution of Omicron-induced symptoms that the prevalence of fever was low among COVID-19 patients during the outbreak of Omicron in Hong Kong and the UK [15, 16]. The specific reasons for this difference need to be explored by further studies.

Our data also indicated that the difference in being symptomatic or asymptomatic COVID-19 patients was associated with psoriatic treatment while not with age, BMI, hypertension, or vaccination status. We observed a relatively lower risk of being symptomatic in the group of TT after controlling relevant confounders. In 2020, a monocenter study presented that 33 out of 180 psoriasis patients had at least one COVID-19 symptom and showed no significant difference in the distribution of signs and symptoms between psoriasis patients who received biologics ($n = 16$) and those treated with topical treatment ($n = 17$), while it did not mention about the asymptomatic rate and related factors [17]. Our findings provide evidence for factors influencing the onset or absence of symptoms in patients with psoriasis after COVID-19 infection during the Omicron period, but the sample size was limited, and a sizeable real-world study is needed to explore this question further.

Regarding the effect of COVID-19 vaccination, previous research presented that patients who received two or three doses had a lower risk of hospitalization during the Omicron pandemic [15]. Whereas, among nonhospitalized Omicron variant-infected patients, evidence suggested that the vaccination status was not associated with the likelihood of being symptomatic or asymptomatic of COVID-19 [16], which is paralleling our results. In this study, we did not present the impact of COVID-19 vaccination on psoriasis flares but we found that previous evidence elucidated this point controversially. In 2021, Sotiriou et al. reported 14 psoriasis exacerbation cases after receiving COVID-19

Table 2: COVID-19-related outcomes.

Variables	Total ($n = 240$)	BIO ($n = 138$)	NBT ($n = 52$)	TT ($n = 50$)	P value
Hospitalization					
Hospitalized	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	—
COVID-19 symptoms[†]*, n = 186*					
With one or more COVID-19 symptoms	186 (77.50)	113 (81.88)	39 (75.00)	34 (68.00)	0.12
The prevalence of each symptom					
Fever	141 (75.81)	83 (73.45)	32 (82.05)	26 (76.47)	0.55
Cough	124 (66.67)	70 (61.95)	29 (74.36)	25 (73.53)	0.24
Fatigue	103 (55.37)	64 (56.64)	21 (53.85)	18 (52.94)	0.91
Sore muscle	94 (50.54)	57 (50.44)	20 (51.28)	17 (50.00)	0.99
Expectoration	79 (42.47)	46 (40.71)	16 (41.03)	17 (50.00)	0.62
Chilly	77 (41.40)	43 (38.05)	21 (53.85)	13 (38.24)	0.21
Back pain	67 (36.02)	44 (38.94)	11 (28.21)	12 (35.29)	0.48
Anosmia/Ageusia	64 (34.41)	39 (34.51)	17 (43.59)	8 (23.53)	0.20
Headache	63 (33.87)	39 (34.51)	12 (30.77)	12 (35.29)	0.90
Sore throat	59 (31.72)	32 (28.32)	12 (30.77)	15 (44.12)	0.22
Stuffiness	58 (31.18)	29 (25.66)	14 (35.90)	15 (44.12)	0.097
Dizzy	40 (21.51)	27 (23.89)	6 (15.38)	7 (20.59)	0.53
Joint pain	35 (18.82)	22 (19.47)	9 (23.08)	4 (11.76)	0.45
Gastrointestinal disorder	24 (12.90)	13 (11.50)	5 (12.82)	6 (17.65)	0.64
Shortness of breath (dyspnea)	24 (12.90)	13 (11.50)	8 (20.51)	3 (8.82)	0.26
Nausea	13 (6.99)	8 (7.08)	2 (5.13)	3 (8.82)	0.47
Chest pain	8 (4.30)	6 (5.31)	1 (2.56)	1 (2.94)	0.43
Duration of COVID-19 symptoms					
≤7 d	138 (74.19)	84 (74.34)	28 (71.80)	26 (76.47)	0.90
>7 d	48 (25.81)	29 (25.66)	11 (28.20)	8 (23.53)	
Skin manifestations after infection					
No aggravation	157 (65.42)	100 (72.46)	28 (53.85)	29 (58.00)	**0.026**
With skin manifestation (s)	83 (34.58)	38 (27.54)	24 (46.15)	21 (42.00)	
New plaque/guttate lesions	60 (25.00)	29 (21.01)	18 (34.62)	13 (26.00)	0.15
Itching	33 (13.75)	10 (7.25)	11 (21.15)	12 (24.00)	**0.003**
Scaly	29 (12.08)	8 (5.80)	8 (15.38)	13 (26.00)	**<0.001**

Continuous variables are performed as the mean (SD) and categorical variables, as count (%). Accurate statistics are chosen for the data, including one-way analysis of variance (ANOVA), Kruskal–Wallis test, and Pearson's χ^2 test (or Fisher's exact test). A P value <0.05 is considered significant and marked into bold. [†]Patients might have more than one symptom so that the sum of the percentages is over 1. Abbreviations: BIO: biologics, NBT: nonbiological treatment, and TT: topical treatment or without pharmacological therapy.

Table 3: Multivariate logistic regression models for developing symptomatic or asymptomatic COVID-19.

Variables	Minimally adjusted OR (95% CI)[†]	P value	Fully adjusted OR (95% CI)[‡]	P value
Treatment group				
BIO	References	—	References	—
NBT	0.61 (0.28–1.35)	0.210	0.58 (0.26–1.31)	0.18
TT	**0.41 (0.19–0.89)**	**0.023**	**0.40 (0.18–0.90)**	**0.025**
Gender	1.63 (0.81–3.4)	0.182	1.25 (0.56–2.81)	0.59
Age	0.98 (0.96–1.01)	0.148	0.98 (0.95–1.01)	0.17
BMI	1.00 (0.91–1.11)	0.979	1.01 (0.91–1.12)	0.86
Hypertension	—	—	1.51 (0.49–5.39)	0.50
Smoking status	—	—	0.57 (0.27–1.17)	0.13
Vaccination	—	—	1.81 (0.75–4.90)	0.21

A P value <0.05 is considered significant and marked into bold. [†]Minimally adjusted OR contains age, gender, BMI, and treatment groups. [‡]Fully adjusted OR contains age, gender, BMI, hypertension, smoking status, vaccination, and treatment groups. Abbreviations: BMI: body mass index, BIO: biologics, CI: confidence interval, NBT: nonbiological treatment, OR: odds ratio, and TT: topical treatment or without pharmacological therapy.

vaccination and three of them were under the treatment of biologics [18]. Comparatively, some recent studies found that COVID-19 vaccination does not induce psoriasis or psoriatic arthritis flares among patients treated with biologics [19, 20]. Following these findings, in 2023, a multicenter case-control study in Italy also showed no increased flare rate among patients with controlled psoriasis under biological treatment during 24-week observation [21]. Based upon this, we considered that the COVID-19 vaccination should be recommended to most psoriasis patients

Table 4: Bivariate logistic regression models for dyspnea attributed to COVID-19.

Variables	Group NBT vs. BIO adjusted OR (95% CI)	P value	Group TT vs. BIO adjusted OR (95% CI)	P value	Confounder OR (95% CI)	P value
Gender	1.76 (0.66–4.48)	0.242	0.60 (0.13–1.98)	0.446	1.45 (0.61–3.42)	0.39
Age	1.78 (0.66–4.58)	0.240	0.63 (0.14–2.10)	0.488	1.00 (0.97–1.04)	0.84
BMI	1.76 (0.66–4.48)	0.242	0.63 (0.14–2.09)	0.487	1.01 (0.90–1.14)	0.83
Hypertension	1.79 (0.66–4.62)	0.233	0.64 (0.14–2.15)	0.505	1.25 (0.27–4.22)	0.74
Smoking status	1.67 (0.62–4.26)	0.295	0.60 (0.13–1.98)	0.446	2.46 (0.94–7.67)	0.086
Vaccination	1.71 (0.63–4.36)	0.267	0.56 (0.12–1.86)	0.389	1.84 (0.62–4.85)	0.24

The P value < 0.05 is considered significant. Abbreviations: BMI: body mass index, BIO: biologics, CI: confidence interval, NBT: nonbiological treatment, OR: odds ratio, and TT: topical treatment or without pharmacological therapy.

Table 5: Multivariate logistic regression models for skin manifestations after COVID-19.

Variables	Minimally adjusted OR (95% CI)[†]	P value	Fully adjusted OR (95% CI)[‡]	P value
Treatment group				
BIO	Ref	—	Ref	—
NBT	**2.21 (1.12–4.36)**	**0.022**	**2.15 (1.08–4.27)**	**0.029**
TT	1.93 (0.95–3.92)	0.07	1.94 (0.94–4.00)	0.073
Gender	1.57 (0.85–2.92)	0.154	1.26 (0.64–2.47)	0.50
Age	0.98 (0.96–1.00)	0.115	0.98 (0.96–1.01)	0.21
BMI	1.08 (1–1.18)	0.066	**1.10 (1.00–1.20)**	**0.042**
Hypertension	—	—	0.93 (0.29–2.67)	0.90
Smoking	—	—	0.59 (0.30–1.14)	0.12
Vaccination	—	—	1.24 (0.59–2.55)	0.57

A P value <0.05 is considered significant and marked into bold. [†]Minimally adjusted OR contains age, gender, BMI, and treatment groups. [‡]Fully adjusted OR contains age, gender, BMI, hypertension, smoking status, vaccination, and treatment groups. Abbreviations: BMI: body mass index, BIO: biologics, CI: confidence interval, NBT: nonbiological treatment, OR: odds ratio, Ref: reference (as a reference group in the models), and TT: topical treatment or without pharmacological therapy.

according to the NPF COVID-19 task force guidance in this pandemic [8] and more evidence is required for exploring the impact of COVID-19 vaccination on psoriasis.

The COVID-19 infection's impact on the worsening effect of psoriasis remains a hot topic. Previous research suggested that no adherence to the biologics was related to the psoriasis flare-up [22]. Although the infection of SARS-CoV-2 might play a crucial direct role in psoriasis aggravation, the pieces of literature about it were mainly presented as cases. We reported the proportion of the incidence of new lesions, pruritus aggravation, and increased desquamation in three treatment groups (BIO, NBT, and TT) within two weeks after the infection, which complemented to the direct impact of the Omicron variant on the exacerbation of psoriasis. Interestingly, high BMI and the NBT were considered as correlative factors to developing cutaneous signs after COVID-19 infection.

There are some limitations in this present study. First, the sample size is relatively small, which might lead to bias. That might also result in only one comorbidity variable, hypertension, being included in the multivariate logistic model due to its significant difference among the three groups. Second, we collected patients' self-report evaluation of the presence of the new lesions after Omicron variant infection, which might differ from the results of lesions evaluation made by dermatologists. In the future, large-scale studies are needed to explore the impact of differential psoriatic treatment on the Omicron variant symptomatic infection and Omicron's direct impact on the condition of psoriasis. Furthermore, a long-term follow-up is required for the consistent effect of COVID-19 on psoriasis.

Data Availability

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

Disclosure

Yue Xiao and Xiwen Zhang share the first authorship in this work.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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Supplementary Materials

Supplementary file 1: The characteristics of PASI changes. (*Supplementary Materials*)

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