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Enhanced impact of psoriasis severity on the treatment demands of patients during the COVID-19 pandemic: a cross-sectional study based on a national psoriasis registry in China

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ABSTRACT

Objectives The personalised treatment demands of patients with psoriasis did not get significant attention during the pandemic lockdown. This study aimed to investigate the treatment demands of patients with psoriasis with different severities, stratified by COVID-19 pandemic conditions.

Design Cross-sectional study design.

Setting Multicentre study based on a national psoriasis registry in China.

Participants A total of 22 425 adult patients with psoriasis were enrolled between August 2020 and September 2021.

Primary and secondary outcome measures The primary outcomes were patient demands for quick healing of skin lesions and improving mental health, which were collected by questionnaires. Multivariable logistic models were used to examine the impact of disease severity, as measured by Psoriasis Area and Severity Index (PASI), body surface area (BSA) and Investigator's Global Assessment (IGA), on treatment demands, as stratified by COVID-19 pandemic conditions (lockdown vs non-lockdown).

Results Increasing PASI score significantly increased patient demands for rapid healing of skin lesions and improving mental health during non-lockdown periods. The magnitude of both associations further increased during the COVID-19 lockdown from an OR of 1.45 (95% CI 1.27 to 1.65) to 2.19 (95% CI 1.57 to 3.05) and 2.21 (95% CI 2.03 to 2.40) to 2.82 (95% CI 2.24 to 3.55), respectively. The skin lesion healing demand was more triggered by the overall irritation level (measured by IGA, OR 1.64, 95% CI 1.35 to 1.99 during non-lockdown periods vs OR 2.70, 95% CI 1.63 to 4.49 during lockdowns), while the mental health improving demand was more triggered by lesion coverage (measured by BSA, OR 2.01, 95% CI 1.85 to 2.19 vs OR 3.27, 95% CI 2.57 to 4.15).

Conclusions Psoriasis aggravation significantly increased patients' treatment demands, especially during lockdowns. The used psoriasis severity measures highlighted patients' treatment demands differently. This suggests more accessible and personalised healthcare for patients with psoriasis should be available during future pandemics.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This is, to date, the largest study investigating the association between psoriasis severity and treatment demands from the patients' perspective, and the first study comparing the aforementioned association between a lockdown and a non-lockdown period.
⇒ Disease severity was assessed with different measures and from different aspects, making the results comprehensive and robust.
⇒ Subjects who participated in our programme were enrolled from specific dermatological clinics, and thus may not represent the general psoriasis population.
⇒ The demand for improving mental health was collected as a binary variable without professional psychological assessment.

INTRODUCTION

Psoriasis is a chronic, non-fatal disease primarily affecting the skin. The prevalence of psoriasis varies geographically, with 0.14% and 1.99% of the population in East Asia and Australasia being affected, respectively.[1] In China, the prevalence was 0.12% in 1987 and 0.47% in 2012.[2] Apart from skin lesions, psoriasis is also now recognised as a systemic inflammatory disorder that relates to various comorbidities, such as metabolic syndrome, arthritis, malignancy and so on.[3] Poor appearances, together with comorbidities, significantly impair patients' daily functioning and cause significant psychological distress,[4] which can result in depression, suicidal ideation and substance abuse,[5–8] causing high social burdens, especially during the recurrent COVID-19 pandemics.[9–11]

Current clinical diagnosis and treatment for psoriasis must follow appropriate guidelines and consensus. Therefore, the choice of

treatment for psoriasis primarily depends on the objective assessment of lesion severity of the disease, yet the demands of the patient are often neglected.[12 13] However, due to the chronic, non-fatal characteristics of psoriasis, individual perceptions of the disease can determine the impact of psoriasis on the quality of life of patients, which may then affect their treatment demands.[14 15] Thus, the treatment decisions should be driven by the real needs and expectations of each individual.

Furthermore, since healthcare access (eg, emerged telemedicine),[16–19] as well as the clinicians' treatment considerations to control psoriasis, have all changed during the recurrent COVID-19 pandemics,[20] patients' mental health condition, their perception of psoriasis and further treatment demands may altered accordingly.[21–23] From the treatment-decision aspect, the initiation of biologics for psoriasis decreased sharply during the COVID-19 pandemic, possibly due to the poor access to healthcare for patients and the lack of evidence on the relationship between COVID-19 infection and biological therapies for psoriasis at the beginning of the pandemic.[24 25] From a healthcare-seeking behaviour perspective, patients with psoriasis tended to cancel or defer their appointments, lose adherence to treatment and require prolonged prescription or treatment change during the COVID-19 pandemic.[9 26–28] All the above changes may be associated with deterioration of psoriasis and further symptoms of anxiety and depression,[11 22 29 30] although the association is complex and undetermined.[10 27] In contrast, from a quality-of-life perspective, the social-activity aspect assessed in a quality-of-life questionnaire became irrelevant during lockdown, which led to paradoxically improved quality of life among patients with psoriasis during the COVID-19 lockdown.[10 31] Patients may perceive their psoriasis lesions as more acceptable because they are less worried about skin lesion appearances due to restricted social activities, and are more fearful of COVID-19 when receiving immunosuppressive treatment for psoriasis.[23] As a result, how patients' treatment demands changed during pandemics remains unknown. Thus, it is essential to reassess patients' treatment demands to improve personalised treatment during the pandemic. However, studies on changes in treatment demands from patients' perspectives during pandemics are limited.

This study aimed to examine the treatment demands of patients with psoriasis with varying disease severity and other clinical and personal characteristics in a real-world setting throughout the recurrent COVID-19 pandemic, hoping to provide references for personalised treatment strategies not only for patients with psoriasis during the COVID-19 pandemic but also for patients with all other chronic diseases in any future pandemic lockdowns.

MATERIALS AND METHODS

Study design, patients and data collected

This was a cross-sectional, multicentre study based on a nationwide real-world big data collection platform established by the Psoriasis Standardized Diagnosis and Treatment Center (also named Psoriasis Center) and led by the National Clinical Research Center for Skin and Immune Disease.[32] This data platform is the first and currently the largest psoriasis registry in China, and as of September 2021, had included data of 32 014 patients with psoriasis from 228 hospitals across China. The registry collects data on demographics, medical history, clinical assessment, previous and current treatments for psoriasis, self-reported quality of life, and treatment demands at enrolment. The data preprocessing standards for derived variables and variables with potentially mistaken values are listed in online supplemental table S1.

All patients aged ≥18 years enrolled between August 2020 and September 2021 with complete baseline data were included. The differences in baseline characteristics between patients with complete and incomplete data are shown in online supplemental table S2.

Patient and public involvement

Patients were not involved in the design, conduct, reporting or dissemination plans of our research.

Study measures

The study outcomes were patients' treatment demands, which were all collected through 'yes-or-no' questions in a face-to-face interview. The two primary treatment demands contained healing skin lesions quickly and improving mental health. The questionnaire also asked about other demands, including reducing social discrimination, working and socialising normally, relieving itchy feelings, relieving painful or burning feelings, and reducing the side effects of treatment and disease relapses. All the aforementioned treatment demands were treated as binary variables. Quality of life was additionally assessed by the Dermatology Life Quality Index (DLQI).

The main exposure was psoriasis severity, which was assessed by the Psoriasis Area and Severity Index (PASI), body surface area (BSA) and the 5-point Investigator's Global Assessment (IGA).[12 13] According to the guidelines for the diagnosis and treatment of psoriasis in China (2023),[33] PASI score was categorised as mild (<3), moderate (3 to <10) and severe (≥10), whereas BSA (%) was categorised as mild (<3%), moderate (3% to <10%) and severe (≥10%). The 5-point IGA categorised the severity level as clear/almost clear (0/1), mild (2), moderate (3) and severe (4).

Provincial COVID-19 data weres summarised from the official website of the National Health Commission of the People's Republic of China (http://www.nhc.gov.cn/xcs/yqtb/list_gzbd.shtml). Considering the maintenance period of both epidemic control measures and public response to the pandemic, the 7 days following the last day in which a new case was recorded were further classified into the same pandemic period. The COVID-19 pandemic variable was treated as binary according to the geographical location and enrolled day of each patient.

Statistical analysis

Descriptive statistics were performed for each variable stratified by each treatment demand using frequencies (percentages) for categorical variables and median (IQR) for continuous variables. Categorical variables were compared using χ^2 tests, whereas continuous variables were compared using the Kruskal-Wallis H test.

Multivariable logistic regression models were used to investigate the impact of psoriasis severity, as measured by PASI, BSA and IGA, separately, on each treatment demand stratified by whether the patient was enrolled during the COVID-19 pandemic. To reduce potential confounding factors, all models were adjusted for demographic characteristics (sex, age, body mass index (BMI), marriage status, education, employment and smoking habits) and clinical characteristics (psoriasis duration, family history, disease phenotype, nail/scalp/genital/palmoplantar involvement, comorbidities and previous treatment). PASI, BSA and IGA values were separately modelled in relation to each treatment demand and were treated as continuous and categorical variables separately. A Q-test attached to the fixed effect model was performed to detect the heterogeneity between the impact of psoriasis severity on treatment demands during the COVID-19 pandemic lockdowns and normal periods. Mediation analysis was employed to investigate the effect of PASI/BSA/IGA on treatment demands mediated by DLQI, adjusting for the same confounding set above and additionally for COVID-19 lockdowns. Other potential factors influencing the treatment demands were examined using the same multivariable logistic regression models investigating the impact of PASI on quick skin healing and mental health improvement demands while adding the COVID-19 pandemic as a covariate. All data analyses were conducted using STATA/SE (StataCorp LLC 2021, Stata Statistical Software: Release V.17), and a $p<0.05$ was considered statistically significant.

RESULTS

General characteristics

Among the 29 412 adult patients enrolled as of September 2021 (online supplemental table S2), 22 425 with complete baseline information from 212 tertiary hospitals across China were enrolled in this study. Exactly 65.0% of patients were men (n=14 567). The median age was 40 (IQR, 31–54) years, and the percentages of different age groups were as follows: 18–45 years, 60.3% (n=13 515); 46–60 years, 26.9% (n=6033); ≥61 years, 12.8% (n=2877). The median PASI and DLQI scores were 7.2 and 8, respectively. Exactly 12.1% of the patients (n=2706) were enrolled during a COVID-19 lockdown in their provinces. Moreover, 89.7% (n=20 111) and 38.0% (n=8531) of the patients demanded a speedy healing of the skin lesions and mental health improvement, respectively (table 1).

Patients demanding the rapid healing of skin lesions tended to be female, younger, employed, unmarried, have a college degree, have current smoking habits, enrolled during a normal period without the COVID-19 lockdown, have a shorter psoriasis duration, have a positive family history, have pustular or guttate psoriasis, have nail or scalp involvement and have a severer psoriasis condition, as measured by PASI, BSA and IGA, while not having palmoplantar involvement, comorbidities, such as psoriatic arthritis or a history of use of biologics (all $p<0.05$). By comparison, patients demanding mental health improvement tended to be unemployed, have a longer psoriasis duration, have plaque, erythrodermic or arthropathic psoriasis, have lesions on special areas including nails, scalps, hands/soles, and genitals, have more severe psoriasis conditions, and have deteriorated quality of life, while not having a college degree, smoking habits, pustular or guttate psoriasis or comorbidities (all $p<0.05$). Patients' characteristics stratified by other treatment demands are shown in online supplemental table S3.

Impact of psoriasis severity on treatment demands stratified by the COVID-19 pandemic

Both multivariable logistic regression and trend tests confirmed that the increasing psoriasis severity, as measured by PASI, significantly stimulated patients' primary treatment demands of healing skin lesions rapidly (OR, 1.45; 95% CI 1.27 to 1.65; $p<0.001$ for severe PASI vs mild PASI; and OR 1.02; 95% CI 1.01 to 1.02; $p<0.001$ in the trend test) and improving mental health (OR 2.21; 95% CI 2.03 to 2.40; $p<0.001$ for severe PASI vs mild PASI; and OR 1.03; 95% CI 1.02 to 1.03; $p<0.001$ in the trend test) during a normal period without COVID-19 lockdown (shown in figure 1A,B; and online supplemental table S4). The disease severity-triggered primary treatment demands further increased during the COVID-19 lockdowns, including healing skin lesions rapidly (OR 2.19; 95% CI 1.57 to 3.05 for severe PASI vs mild PASI; $p<0.001$) and improving mental health (OR 2.82; 95% CI 2.24 to 3.55 for severe PASI vs mild PASI, $p<0.001$), despite the statistical insignificance (both $p=0.064$ in the heterogeneity Q-test). Other treatment demands, including reducing social discrimination, working and socialising normally, relieving painful or burning feelings, relieving itchy feelings and reducing the treatment side effects, were also significantly stimulated by deteriorated skin conditions measured by PASI (all $p<0.05$); moreover, the degree of this stimulation further intensified during the COVID-19 lockdown (shown in figure 1C–G). The exception was the demand for reducing relapses, which significantly declined as PASI increased. Nevertheless, the magnitude of this decline decreased during the pandemic lockdown (OR 0.61; 95% CI 0.49 to 0.75, $p<0.001$ for severe PASI vs mild PASI during a non-COVID-19 period and OR 0.81; 95% CI 0.58 to 1.12; $p=0.196$

Table 1 Demographic and clinical characteristics stratified by primary treatment demands

	Healing skin lesions rapidly			Improving mental health			
	Yes (n=20 111)	No (n=2314)	P value	Yes (n=8531)	No (n=13 894)	P value	Total (n=22 425)
Male, n (%)	13 005 (64.7)	1562 (67.5)	0.007	5491 (64.4)	9076 (65.3)	0.144	14 567 (65.0)
Age, y, median (IQR)	40 (31–53)	42 (33–55)	<0.001	40 (31–53)	40 (31–54)	0.227	40 (31–54)
BMI, kg/m^2, median (IQR)	24.0 (21.7–26.7)	24.2 (21.9–26.9)	0.099	24.0 (21.8–26.7)	24.1 (21.7–26.8)	0.405	24.0 (21.7–26.7)
Unemployment*, n (%)	1755 (11.2)	239 (13.3)	0.001	833 (12.3)	1161 (10.8)	0.003	1994 (11.4)
Married, n (%)	15 316 (76.2)	1888 (81.6)	<0.001	6544 (76.7)	10 660 (76.7)	0.979	17 204 (76.7)
Bachelor's degree, n (%)	7064 (35.1)	764 (33.0)	0.044	2860 (33.5)	4968 (35.8)	0.001	7828 (34.9)
Current smoker, n (%)	5443 (27.1)	580 (25.1)	0.040	2119 (24.8)	3904 (28.1)	<0.001	6023 (26.9)
COVID-19 lockdown, n (%)	2394 (11.9)	312 (13.5)	0.027	1032 (12.1)	1674 (12.1)	0.913	2706 (12.1)
Psoriasis duration, year, median (IQR)	6 (2–14)	8 (2–15)	<0.001	8 (2–15)	6 (1–14)	<0.001	6 (2–14)
Family history, n (%)	3459 (17.2)	357 (15.4)	0.032	1452 (17.0)	2364 (17.0)	0.991	3816 (17.0)
Psoriasis phenotype†, n (%)							
Plaque psoriasis	16 335 (81.2)	1896 (81.9)	0.406	7105 (83.3)	11 126 (80.1)	<0.001	18 231 (81.3)
Erythrodermic psoriasis	219 (1.1)	23 (1.0)	0.675	121 (1.4)	121 (0.9)	<0.001	242 (1.1)
Pustular psoriasis	609 (3.0)	49 (2.1)	0.014	216 (2.5)	442 (3.2)	0.005	658 (2.9)
Guttate psoriasis	2739 (13.6)	277 (12.0)	0.028	978 (11.5)	2038 (14.7)	<0.001	3016 (13.4)
Arthropathic psoriasis	1293 (6.4)	297 (12.8)	<0.001	668 (7.8)	922 (6.6)	0.001	1590 (7.1)
Lesions on special areas, n (%)							
Nail	4861 (24.2)	504 (21.8)	0.011	2130 (25.0)	3235 (23.3)	0.004	5365 (23.9)
Scalp	13 127 (65.3)	1451 (62.7)	0.014	5709 (66.9)	8869 (63.8)	<0.001	14 578 (65.0)
Palmoplantar	3928 (19.5)	530 (22.9)	<0.001	1863 (21.8)	2595 (18.7)	<0.001	4458 (19.9)
Genital	2681 (13.3)	333 (14.4)	0.157	1281 (15.0)	1733 (12.5)	<0.001	3014 (13.4)
Disease severity, median (IQR)							
PASI	7.2 (3.0–15.0)	5.9 (2.6–12.0)	<0.001	9.1 (3.9–17.4)	6.0 (2.7–12.8)	<0.001	7.2 (3.0–14.6)
BSA, %	10.0 (3.0–30.0)	9.2 (3.0–22.4)	<0.001	14.0 (5.0–30.0)	8.0 (3.0–25.0)	<0.001	10.0 (3.0–30.0)
IGA	3 (2–3)	2 (2–3)	<0.001	3 (2–3)	3 (2–3)	<0.001	3 (2–3)
DLQI, median (IQR)	8 (3–12)	8 (2–12)	0.072	10 (6–15)	6 (2–10)	<0.001	8 (3–12)
Comorbidity‡, n (%)	2850 (14.2)	395 (17.1)	<0.001	1177 (13.8)	2068 (14.9)	0.010	3245 (14.5)
Previous use of biologics§	1726 (8.6)	256 (11.1)	<0.001	732 (8.6)	1250 (9.0)	0.286	1982 (8.8)

*The unemployment rate was calculated in the working-age population, which excluded retired patients and students.
†Phenotypes were not mutually exclusive, thus the total percentage was higher than 100%.
‡Comorbidity presented the existence of any disease conditions, including cardiovascular diseases, respiratory diseases, kidney diseases, rheumatic diseases, digestive diseases, tumours, endocrine diseases and so on.
§Biologics included tumour necrosis factor-α inhibitors and interleukin inhibitors.
BMI, body mass index; BSA, body surface area; DLQI, Dermatology Life Quality Index; IGA, Investigator's Global Assessment; PASI, Psoriasis Area and Severity Index.

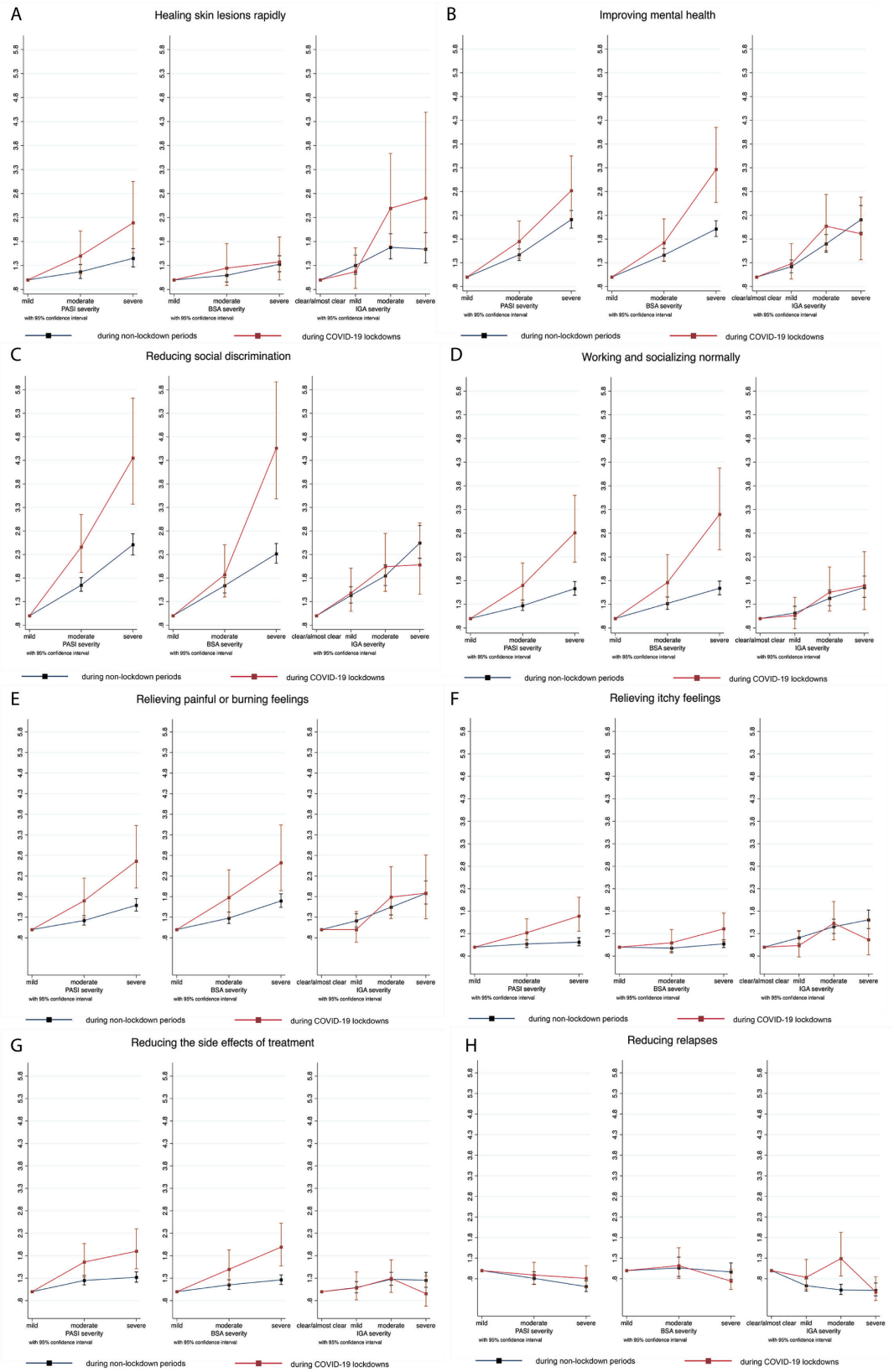

Figure 1 OR for the association between each treatment demand and psoriasis severity by different measures (PASI/BSA/IGA) during COVID-19 lockdowns (red line) and non-lockdown periods (blue line). (A) Treatment demand for healing skin lesions rapidly. (B) Treatment demand for improving mental health. (C) Treatment demand for reducing social discrimination. (D) Treatment demand for working and socialising normally. (E) Treatment demand for relieving painful or burning feelings. (F) Treatment demand for relieving itchy feelings. (G) Treatment demand for reducing the side effects of treatment. (H) Treatment demand for reducing relapses. BSA, body surface area; IGA, Investigator's Global Assessment; PASI, Psoriasis Area and Severity Index.

during a COVID-19 lockdown; heterogeneity Q-test, p=0.001; shown in figure 1H).

Impact of psoriasis severity by different instruments on treatment demands stratified by the COVID-19 pandemic

Similar patterns of change in each treatment demand were also found as BSA and IGA increased during the normal period. However, the two measures motivated the treatment demands slightly differently during the pandemic lockdowns. Specifically, the magnitude of increasing BSA-triggered demands of rapidly healing skin lesions hardly changed during the pandemic lockdowns (OR 1.33; 95% CI 1.17 to 1.50; p<0.001 for severe BSA vs mild BSA during a normal period and OR 1.38; 95% CI 0.999 to 1.896; p=0.051 during the pandemic lockdown; heterogeneity Q-test, p=0.663), whereas that of IGA-triggered demands significantly increased (OR 1.64; 95% CI 1.35 to 1.99; p<0.001 for IGA=4 vs IGA=0/1 during the normal period and OR 2.70; 95% CI 1.63 to 4.49; p<0.001 during the pandemic lockdown; heterogeneity Q-test, p=0.005). In contrast, the magnitude of the increase in demands of improving mental health triggered by BSA significantly increased during the pandemic (OR 2.01; 95% CI 1.85 to 2.19; p<0.001 and OR 3.27; 95% CI 2.57 to 4.15; p<0.001; heterogeneity Q-test, p<0.001), whereas that triggered by IGA hardly changed (OR 2.21; 95% CI 1.94 to 2.51; p<0.001 and OR 1.91; 95% CI 1.36 to 2.68; p<0.001; heterogeneity Q-test, p=0.971; shown in figure 1A,B and online supplemental tables S5 and S6).

Impact of psoriasis severity on treatment demands mediated by quality of life

Further mediation analysis showed that increasing PASI motivated patients' treatment demands mainly by deteriorating their quality of life, including improving mental health (47.1%), reducing social discrimination (mediated proportion, 49.0%), working and socialising normally (72.1%), relieving painful (40.8%) or itchy (73.2%) feelings and reducing the treatment side effects (74.3%). However, the proportion of the DLQI-mediated effect was small in the total effect of PASI on the demands for reducing relapses (7.6%) and quickly healing skin lesions (0.6%). The aforementioned results were replicated when disease severity was examined by BSA and IGA (table 2).

Potential factors influencing treatment demands

Apart from disease severity, multivariable logistic regression analysis also identified female sex (OR 1.23; 95% CI 1.11 to 1.36; p<0.001), smoking status (OR 1.17; 95% CI 1.04 to 1.30; p=0.005), pustular psoriasis (OR 1.71; 95% CI 1.26 to 2.32; p=0.001) and nail involvement (OR 1.28; 95% CI 1.14 to 1.44, p<0.001) to be significantly correlated with a higher demand for quick skin lesion healing. However, older age (OR 0.994; 95% CI 0.991 to 0.998; p=0.004), married status (OR 0.82; 95% CI 0.72 to 0.94; p=0.003), unemployed status (OR 0.82; 95% CI 0.70 to 0.95; p=0.010), COVID-19 lockdown (OR 0.87; 95% CI 0.77 to 0.99; p=0.037), arthropathic psoriasis (OR 0.55; 95% CI 0.47 to 0.64; p<0.001), palmoplantar involvement (OR 0.75; 95% CI 0.67 to 0.85; p<0.001) and comorbidities (OR 0.86; 95% CI 0.76 to 0.97; p=0.018) were found to be significantly correlated with lower demand (table 3).

Moreover, the demand for the improvement of mental health was significantly higher in patients with arthropathic psoriasis (OR 1.22; 95% CI 1.09 to 1.37; p=0.001) and palmoplantar involvement (OR 1.09; 95% CI 1.01 to

Table 2 Proportion of causal effect of disease severity on treatment demands, as mediated by quality of life

	PASI			BSA			IGA		
Treatment demands	Indirect effect*	Total effect†	Mediated proportion‡	Indirect effect*	Total effect†	Mediated proportion‡	Indirect effect*	Total effect†	Mediated proportion‡
Healing skin lesions rapidly	<0.001	0.001	0.6%	<0.001	0.001	1.4%	<0.001	0.019	0.3%
Improving mental health	0.009	0.020	47.1%	0.004	0.007	56.7%	0.098	0.186	52.6%
Reducing social discrimination	0.006	0.013	49.0%	0.003	0.005	53.5%	0.064	0.118	54.3%
Working and socialising normally	0.025	0.035	72.1%	0.010	0.015	67.7%	0.260	0.289	90.0%
Relieving painful or burning feelings	0.010	0.024	40.8%	0.004	0.009	45.5%	0.102	0.212	48.2%
Relieving itchy feelings	0.011	0.015	73.2%	0.004	0.003	139.4%	0.106	0.244	43.3%
Reducing the side effects of treatment	0.016	0.021	74.3%	0.006	0.007	83.4%	0.162	0.145	111.9%
Reducing relapses	<0.001	0.003	7.6%	<0.001	0.001	5.9%	0.004	0.079	5.4%

*The indirect effect refers to the effect of PASI/BSA/IGA on each treatment demand mediated by quality of life.
†The total effect refers to the sum of direct effects of PASI/BSA/IGA on each treatment demand and the indirect effects mediated by quality of life.
‡The mediated proportion equals to the indirect effect divided by the total effect.
BSA, body surface area; IGA, Investigator's Global Assessment; PASI, Psoriasis Area and Severity Index.

Table 3 Relationship between other patient characteristics and primary treatment demands

Patient characteristics	Healing skin lesions rapidly		Improving mental health	
	OR (95% CI)	P value	OR (95% CI)	P value
Sex (reference: male)	1.23 (1.11 to 1.36)	<0.001	1.04 (0.98 to 1.11)	0.205
Age	0.994 (0.991 to 0.998)	0.004	0.993 (0.991 to 0.996)	<0.001
Body mass index	0.997 (0.990 to 1.003)	0.281	0.9955 (0.9914 to 0.9996)	0.030
Marriage (reference: unmarried)	0.82 (0.72 to 0.94)	0.003	1.06 (0.98 to 1.14)	0.166
Bachelor's degree	1.01 (0.92 to 1.12)	0.912	0.90 (0.84 to 0.95)	0.001
Unemployment	0.82 (0.70 to 0.95)	0.010	1.08 (0.98 to 1.20)	0.112
Current smoker	1.17 (1.04 to 1.30)	0.005	0.81 (0.75 to 0.86)	<0.001
COVID-19 lockdowns	0.87 (0.77 to 0.99)	0.037	1.02 (0.93 to 1.11)	0.726
Disease course	0.9996 (0.9989 to 1.0004)	0.319	0.9999 (0.9993 to 1.0005)	0.744
Family history	0.93 (0.82 to 1.05)	0.225	1.03 (0.95 to 1.11)	0.457
Psoriasis phenotype (reference: plaque psoriasis)				
Erythrodermic psoriasis	1.19 (0.76 to 1.86)	0.435	1.09 (0.84 to 1.42)	0.503
Pustular psoriasis	1.71 (1.26 to 2.32)	0.001	0.77 (0.65 to 0.92)	0.003
Guttate psoriasis	1.14 (0.9995 to 1.31)	0.051	0.78 (0.71 to 0.84)	<0.001
Arthropathic psoriasis	0.55 (0.47 to 0.64)	<0.001	1.22 (1.09 to 1.37)	0.001
Lesions on specific areas				
Nail	1.28 (1.14 to 1.44)	<0.001	0.97 (0.90 to 1.04)	0.373
Scalp	1.07 (0.97 to 1.18)	0.158	1.0005 (0.94 to 1.06)	0.987
Palmoplantar	0.75 (0.67 to 0.85)	<0.001	1.09 (1.01 to 1.18)	0.027
Genital	0.93 (0.81 to 1.07)	0.323	1.08 (0.99 to 1.17)	0.087
Comorbidity	0.86 (0.76 to 0.97)	0.018	0.90 (0.83 to 0.97)	0.012
Previous use of biologics	0.87 (0.75 to 1.01)	0.077	1.02 (0.92 to 1.13)	0.682

The relationship between other patient characteristics and primary treatment demands was identified by the same logistic regression models examining the impact of PASI on treatment demands.
PASI, Psoriasis Area and Severity Index.

1.18, p=0.027). However, this was lower among patients with older age (OR 0.993; 95% CI 0.991 to 0.996, p<0.001), higher BMI (OR 0.9955; 95% CI 0.9914 to 0.9996; p=0.030), a college education (OR 0.90; 95% CI 0.84 to 0.95; p=0.001), smoking status (OR 0.81; 95% CI 0.75 to 0.86; p<0.001), pustular psoriasis (OR 0.77; 95% CI 0.65 to 0.92; p=0.003), guttate psoriasis (OR 0.78; 95% CI 0.71 to 0.84; p<0.001) and comorbidities (OR 0.90; 95% CI 0.83 to 0.97; p=0.012).

DISCUSSION

In this cross-sectional study, it was observed that patient demands for healing skin lesions and improving mental health significantly increased as psoriasis worsened, especially during the COVID-19 pandemic. Different psoriasis severity measures have different emphases in reflecting patients' treatment demands, which were magnified during the pandemic. The impact of disease severity on most treatment demands was mediated by deteriorated quality of life, except for the demands of rapid skin healing and relapse reduction, and thus other factors that stratified major treatment demands were also examined.

Patient-centred intervention is crucial for the treatment of psoriasis due to the chronic and non-fatal characteristics of the condition, in addition to the considerable disparity in prices of various treatment choices, especially in recent years with recurrent pandemic lockdowns. During a normal period, all treatment demands, ranging from improving the appearance of skin lesions and relieving irritating symptoms to psychological and daily functional support, significantly increased as psoriasis deteriorated, suggesting the need for more intensive treatment and psychological counselling for patients. The only exception was the demand for reducing relapses, which was demanded in only 4.7% of patients and further decreased as disease severity increased, indicating that most Chinese patients have recognised the chronic nature of psoriasis and accepted the recurrent relapses and living with a small number of skin lesions, thereby suggesting that clinicians should be aware that patients may have poor compliance in their remission periods.

Compared with normal periods, all treatment demands, including those for rapidly healing skin lesions and improving mental health, were further triggered by disease

severity during pandemic lockdowns (shown in figure 1). This differed from previous reports, which demonstrated that patients' quality of life, as measured by DLQI, was less influenced by psoriasis during pandemic lockdowns.[10 31] The reason for the difference in results is complex. On one hand, because social activities were restricted, patients worried less about skin lesion appearance when socialising and were more fearful about contracting infectious diseases rather than non-fatal psoriasis. Thus, better quality of life, as indicated by DLQI, was observed.[10 31] Our multivariable logistic models also showed that the COVID-19 pandemic itself was a protective factor in reducing the demands of healing skin lesions (table 3). On the other hand, the restrictions in travelling and difficulties in accessing medical resources may exacerbate psoriasis and enhance treatment demands.[22] Although the pandemic lockdowns reduced the impact of psoriasis on socialising, the pandemic and self-isolations themselves could exert psychological impact on patients with psoriasis, such as health anxiety and low mood,[10 21] creating a vicious circle of worsening mental health and deteriorated psoriasis. Taking all these factors together, the study showed enhanced treatment demands in patients with more severe psoriasis during the pandemic lockdowns, suggesting that patients' treatment demands were more influenced by psoriasis and stress conditions rather than the reduced need for socialising. These indicate for clinicians that a more intensive treatment strategy with lasting effects and enhanced mental support is needed during lockdown. In addition, increasing evidence in recent years has shown that immunosuppressive treatment for psoriasis, including biologics, does not increase the risk of COVID-19 infection or the related complications, reinforcing the necessity of more intensive therapy during the pandemic.[28 34 35] Besides, a more accessible pathway, such as telemedicine and online medicine service, should be promoted as an 'add-on' for in-person clinics,[22 30] to facilitate access to healthcare during pandemic lockdowns. All these factors might be generalised and integrated into the management of other chronic non-fatal diseases,[21] such as atopic diseases, during future pandemics to meet patients' treatment needs.

To further help recognise patients' needs according to their clinical manifestations in daily clinics, this study compared the impact of disease severity by different measures on each treatment demand. PASI, BSA and IGA are all instruments measuring psoriasis severity and were found to be significantly correlated with one another.[36] PASI takes both the area coverage and lesion appearance into account, yet it is time-consuming to calculate. In contrast, BSA and IGA are easier to understand, yet only represent the lesion coverage or lesion appearance.[12 13] In this study, an overall more irritating skin appearance presented by a higher IGA further stimulated the demands for the quick relief of skin lesions themselves during the pandemic lockdown, whereas the larger lesion coverage presented by higher BSA further motivated demands for psychological solutions, including improving mental health and reducing social discrimination. Since PASI is difficult to obtain, this study suggests that BSA should be used as a 'first-line' surrogate to represent the enhanced psychological needs of patients, whereas IGA should be used to represent the increased need for more intensive therapy during pandemic lockdowns.

As most previous studies focused on the quality of life of patients with psoriasis, which revealed that worsened quality of life was associated with worsened psoriasis,[37 38] this study further investigated the impact of psoriasis on treatment demands mediated by quality of life. In this study, quality of life was measured by DLQI, which reflected patients' lesion feelings, daily activities, leisure, work and study, personal relationships and treatment burden. We confirmed that increasing disease severity deteriorated patients' quality of life based on the aforementioned aspects, which further motivated corresponding treatment demands. However, although prevalent in the psoriasis population, <2% of the demand for quick skin lesion healing was mediated by deteriorated quality of life, indicating the existence of other factors influencing treatment demands.

Thus, this study further examined other factors potentially stratifying treatment demands. Young and female patients were found to have worse quality of life in previous studies,[37 39 40] as well as higher treatment demands for rapid skin lesion healing in this study. Unmarried and employed patients without comorbidities were also found to have stronger demands for quick healing. These might be because female, young, unmarried and employed patients have higher requirements for self-image, and patients without comorbidities have fewer concerns regarding polypharmacy and drug interactions due to underlying diseases. Additionally, the same demands for quick healing were higher in patients with pustular psoriasis, which presents with fever, painful skin and frequent flare-ups,[41] and in patients with nail psoriasis, which undermines daily function.[42] Thus, a more intensive treatment strategy is needed for these patients. Additionally, more psychological care should be provided to younger patients without a college education, as they may lack a basic understanding of the disease and were found to have higher demands for mental support in this study. The same support was also needed in patients with arthropathic psoriasis and palmoplantar psoriasis, which were linked with internalised stigma and poorer quality of life.[43 44]

Although, to our knowledge, this study is the largest real-world study to date investigating the treatment demands of patients with psoriasis during the pandemic lockdowns, there were limitations. First, the Psoriasis Center programme enrolled patients from specific dermatological clinics, and a certain proportion of patients declined the enrollment request. Thus, the study population may not represent the general psoriasis population. Second, the demand for improving mental health was collected as a binary variable, while the psychological or psychiatric condition was not systematically assessed using specialised

scales, such as Generalised Anxiety Disorder-2, Patient Health Questionnaire-2 and Short Form-12 Health Survey.[11 22 45] Further studies are warranted to quantitatively investigate patients' mental health condition and the degree of each treatment demand using specialised scales. Third, there was an issue regarding the missing data for this data platform. However, as the missing rate was not high, and missing at random was considered (online supplemental table S2), a complete-case analysis was considered sufficient for handling missing data and, therefore, used. Fourth, since the information on residence place was not collected, the COVID-19 pandemic information was matched to each patient only at a province level, even though the pandemic was prevented with a precise approach in China.

CONCLUSION

An increase in psoriasis severity significantly stimulates patients' treatment demands from quickly healing skin lesions and improving mental health aspects, especially during the pandemic lockdowns, indicating the need for an accessible pathway for patients with psoriasis getting more intensive treatment and mental support during future pandemics. To better recognise and meet patients' treatment demands during the pandemic, we suggest that BSA is used to determine the psychological needs of patients, while IGA should be used to reflect the desire to quickly heal lesions. Other demographic and clinical characteristics of each patient should also be considered for a more personalised treatment strategy during future pandemics. Moreover, since the COVID-19 pandemic is nearing its end in many countries, the results of this study could provide hints for personalised treatment for patients with non-fatal chronic diseases in future pandemic lockdowns.

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