Prevalence and Impact of Unacceptable Symptom State among Patients with Psoriatic Arthritis: Results from the National Psoriasis Foundation's 2019 Annual Survey

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The National Psoriasis Foundation surveyed a random, stratified sample of individuals with psoriatic disease in the United States to determine the prevalence of an unacceptable psoriatic arthritis (PsA) symptom state and its effect on depression and social participation. Acceptable and unacceptable levels of PsA were defined using established cutoff points (acceptable $\leq$4 vs unacceptable >4) on the Psoriatic Arthritis Impact of Disease 9. Psoriasis severity was defined by body surface area: mild < 3%, moderate–severe $\geq$ 3%. Depression was assessed utilizing the Patient Health Questionnaire 2. Social participation was assessed by the Patient Reported Outcome Information Measurement System Ability to Participate in Social Role and Activities-SF4a. The analysis cohort comprised 801 patients with PsA. Unacceptable disease activity level (Psoriatic Arthritis Impact of Disease >4) was reported by 59.6% of participants. After adjusting for age, sex, and psoriasis severity, individuals with likely depression (OR = 0.014, $P < .001$) and those with limited ability to participate in social roles and activities (OR = 0.05, $P < .001$) were less likely to experience acceptable levels of PsA activity. Ultimately, the results demonstrated that most United States patients with PsA have unacceptable levels of disease activity, which is associated with increased prevalence of depression and limitations in social participation.

Keywords: Disease activity, Outcome measures, Psoriasis, Psoriatic arthritis, QOL

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INTRODUCTION

An estimated 3.3 million people in the United States live with psoriatic arthritis (PsA), a chronic inflammatory disease that is a common comorbidity of psoriasis (PsO) (Mease et al, 2013). PsA has a dramatic impact on patients' lives and can lead to permanent impairment and disability (Gudu et al, 2017; Taylor et al, 2010). PsA is associated with diminished QOL, compromised physical function, and disability (Rosen et al, 2012). Individuals with both PsO and PsA report poorer outcomes in these domains than those with PsO only (McDonough et al, 2014; Rosen et al, 2012).

Many efficacious therapies for PsA exist. However, the chronic, heterogeneous nature of the disease and involvement of comorbidities can frustrate long-term disease control. As a result, many patients do not achieve or maintain remission. Therefore, it is important to understand the impact that disease activity and symptom control state have on patient outcomes (Lubrano et al, 2020a, 2015). Lubrano et al (2020a)'s prior study of patients at a rheumatology center taking a disease-modifying antirheumatic drug suggests that as many as 68% of individuals with PsA are in an acceptable symptom state and that these individuals experience better outcomes than those in an unacceptable symptom state. However, access to specialty care from a rheumatologist is limited by a variety of factors, resulting in an estimated 33% of individuals with PsA who do not seek care from rheumatology (Ogdie et al, 2020). Thus, the actual number of patients with an unacceptable symptom state might be deceptively higher than those reported by rheumatology center–based studies. Of note, Lubrano et al (2020a)'s study assessed symptom state using Patient Acceptable Symptom State, a binary single-question tool for evaluating the level of symptoms at which patients consider themselves well.

Psoriatic Arthritis Impact of Disease (PsAID) is a validated patient-reported measure that assesses disease-specific QOL related to living with PsA (Gossec et al, 2014). Prior studies have established cutoff points to determine an acceptable symptom state on the basis of PsAID score. Accordingly, a

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Abbreviations: BSA, body surface area; NPF, National Psoriasis Foundation; PHQ, Patient Health Questionnaire; PROM, patient-reported outcome measure; PROMIS, Patient Reported Outcome Information Measurement System; PsA, psoriatic arthritis; PsAID, Psoriatic Arthritis Impact of Disease; PsO, psoriasis

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PsAID score ≤4 indicates an acceptable symptom state, whereas a PsAID score >4 indicates an unacceptable symptom state (Gossec et al, 2014; Lubrano et al, 2020a). Results from a recent global study of patients with PsA suggest that as many as 84% live with moderate-to-severe levels of disease activity (Coates et al, 2020). Such study, however, did not explore the prevalence of acceptable symptom state.

PsA is frequently associated with comorbidities. These comorbidities have been shown to affect certain disease domains, such as disease activity, patient impact, function, and QOL (Lubrano et al, 2020b; Orbai et al, 2020). Depression is a well-known comorbidity of PsA, with an estimated 20% of patients with PsA experiencing at least mild depression (Zhao et al, 2020). Individuals with PsA experience increased rates of depression compared with individuals with psoriatic skin disease alone, and these rates are 22% higher than those of the general population (McDonough et al, 2014; Wu et al, 2017).

In addition, individuals living with PsA often report experiencing impaired ability to participate in social activities (Gudu et al, 2017). A global study of 1286 patients with PsA who had used ≥1 disease-modifying antirheumatic drug and received care from either a dermatologist or rheumatologist within the last 12 months found that 45% had ceased participating in social activities owing to their condition (Coates et al, 2020). However, this study relied on a single self-reported question regarding the negative impact of PsA rather than a validated patient-reported outcome measure (PROM) to assess social participation ability. The Patient Reported Outcome Information Measurement System (PROMIS) is a robust set of well-validated PROMs, including a brief 4-question measure to assess ability to participate in social roles and activities (Cella et al, 2010). PROMIS may be used widely across various patient populations (Cella et al, 2010). Moreover, its measures have been standardized to the general population, enabling comparison with particular subpopulations (Cella et al, 2010).

Real-world research on the prevalence of unacceptable symptom state and its effect on mental health and social function may inform treatment optimization. The National Psoriasis Foundation (NPF) surveyed a random, stratified sample of individuals with psoriatic disease in the United States from the NPF's constituent database. The objective of this study was (i) to determine the prevalence of unacceptable symptom states among patients with PsA and (ii) to examine the association between unacceptable symptom state with depression and impaired social interaction in a real-world population of patients with PsA in the United States.

RESULTS

A total 1570 individuals completed the survey/interview, yielding a 6.7% response rate.

Of the 1570 individuals who completed the survey, 834 (48.3%) reported PsA diagnosis by a healthcare provider. Of the 834 patients, 801 completed the PsAID-9 and were thus included in the analyses (n = 801). This cohort consisted of 74 patients (9.2%) diagnosed with PsA only and 727 patients (90.8%) diagnosed with PsA and PsO. Participants were mostly female (62.7%), were mostly White or Caucasian (Table 1) (87.9%), were aged >50 years (62.9%), and had mild PsO (body surface area [BSA] < 3%) (54.9%). Overall, fewer participants indicated a likelihood of being depressed (32.1%) than being not depressed (67.4%), and most reported mildly limited (31.5%) to normal (42.7%) ability to participate in social roles and activities. Among all participants, 477 (59.6%) reported unacceptable level of disease activity (PSAID > 4), and 324 (40.4%) reported acceptable level of disease activity. These results are summarized in Table 1.

Statistically significant differences in the rate of unacceptable symptom state were found for age, sex, body mass index, severity of skin disease, and primary type of provider treating PsA. Significantly more females experienced unacceptable PsA symptom state (338) than acceptable symptom state (164) ($P < .001$). Similarly, there were significantly more

Table 1. Patient Demographics

Characteristic	Percentage of Respondents (n)
Disease diagnosed by physician (n = 801)	
PsA only	9.2% (74)
PsO and PsA	90.8% (727)
Age, y (n = 775, missing = 26)	
18–35	7.2% (58)
36–50	26.6% (213)
51–65	45.2% (362)
>65	17.7% (142)
Sex (n=798, missing = 3)	
Female	62.9% (502)
Male	37.1% (296)
Race (n = 788, missing = 13)	
White or Caucasian[1]	87.9% (704)
Black or African American	2.2% (17)
Asian or Asian American	2.4% (19)
American Indian or Alaskan Native	0.8% (6)
Native Hawaiian or Pacific Islander	0.3% (2)
Two or more races	2.4% (19)
Unsure	1.0% (8)
Other	1.6% (13)
Ethnicity (n = 799, missing = 2)	
Latinx	9.1% (73)
Psoriasis severity (n = 712, missing = 89)	
Mild	54.9% (440)
Moderate–severe	34.0% (272)
PsA symptom state (n = 801)	
Unacceptable	59.6% (477)
Acceptable	40.4% (324)
PHQ-2 score (n = 797, missing = 4)	
PHQ-2 < 3	67.4% (540)
PHQ-2 ≥ 3	32.1% (257)
Ability to participate in social roles and activities (n = 793, missing = 8)	
Normal	42.7% (342)
Mild limitation	31.5% (252)
Moderate limitation	19.0% (152)
Severe limitation	5.9% (47)

Abbreviations: PHQ-2, Patient Health Questionnaire 2; PsA, psoriatic arthritis; PsO, psoriasis.

[1]The term Caucasian is no longer considered appropriate when identifying participants as White; however, because the survey was distributed with this terminology, the authors have chosen to keep that terminology in the text.

individuals with overweight or obese body mass index among the unacceptable symptom state group (359) than in the acceptable symptom state group (214) ($P < .001$). Likewise, significantly more patients with moderate–severe PsO (191) and with nondermatologist/rheumatologist primary PsA providers (72) reported unacceptable symptoms than those who reported acceptable symptoms (81 and 23, respectively) ($P < .001$) (Table 2).

Chi-square analysis revealed statistically significant differences in the ability to participate in social roles and activities and depression on the basis of symptom state. Participants with an acceptable symptom state reported higher rates of normal ability to participate in social roles and activities (81.2 vs 17.5%), whereas those with an unacceptable symptom state reported higher rates of mild (41.8 vs 16.9%), moderate (30.8 vs 1.9%), and severe (9.9 vs 0%) limitations in their ability to participate in social roles and activities ($P < .001$) (Figure 1). Participants with unacceptable symptoms reported higher rate of depression than those with acceptable symptoms (47.7 vs 9.6%, $P < .001$). In addition, participants with acceptable symptoms reported higher rates of unlikely depression than those with unacceptable symptoms (90.4 vs 52.3%, $P < .001$).

Table 2. Chi-Square Test of Association between Patient Characteristics and Acceptable/Unacceptable Symptom State

Characteristic	Unacceptable PsA (n)	Acceptable PsA (n)
Disease diagnosed by healthcare provider		
PsA only (n = 74)	62.2% (46)	37.8% (28)
PsA and PsO (n = 727)	59.3% (431)	40.7% (296)
Age[1], y		
18–35	6.9% (32)	8.3% (26)
36–50	27.8% (128)	27.1% (85)
51–65	51.0% (235)	40.4% (127)
>65	14.3% (66)	24.2% (76)
BMI[2]		
Normal or underweight	18.4% (81)	30.5% (94)
Obese or overweight	81.6% (359)	69.5% (214)
Sex[2]		
Female	71.0% (338)	50.9% (164)
Male	29.0% (138)	49.1% (158)
Psoriasis severity (by BSA)[2]		
Mild	54.5.0% (229)	72.3% (211)
Moderate–severe	45.5% (191)	27.7% (81)
Treatments used		
Biologic	69.0% (325)	70.2% (226)
Phototherapy	11.0% (52)	10.2% (33)
Topical medication	67.7% (319)	57.5% (185)
Oral therapies	46.1% (217)	35.1% (113)
OTC	48.4% (228)	33.5% (108)
None	3.8% (18)	2.5% (8)
Provider type[2]		
Rheumatologist	51.9% (245)	49.4% (160)
Dermatologist	25.2% (119)	35.8% (116)
All other providers	22.9% (72)	14.8% (23)

Abbreviations: BMI, body mass index; BSA, body surface area; OTC, over the counter; PsA, psoriatic arthritis; PsO, psoriasis.
[1]Chi-square $P \leq .01$.
[2]Chi-square $P \leq .001$.

In unadjusted ANOVA models comparing depression and ability to participate in social roles and activities between individuals with unacceptable levels of PsA activity and individuals with acceptable levels of PsA activity, individuals with unacceptable levels of PsA activity scored higher on the Patient Health Questionnaire (PHQ) 2 (mean = 2.70 [SD = 2.00] vs mean = 0.82 [SD = 1.24], $P < .001$) and scored lower on the PROMIS ability to participate in social roles and activities (mean = 40.78 [SD = 6.91] vs mean = 52.16 [SD = 6.90]). A score of 3 or more on the PHQ-2 is indicative of depression. Individuals with a score of 3 have a 75% probability of experiencing depression (Kroenke et al., 2003). For the PROMIS ability to participate in social roles and activities, a score of 50 indicates normal ability to participate in this domain, with lower scores indicating increased limitations in ability to participate in social roles and activities (Cella et al., 2019). A score of 40 suggests mild/moderate limitation in this domain. Individuals with likely depression were 88% less likely ($P < .001$) to report acceptable levels of PsA than those who were not likely to have depression (Table 3). Similarly, individuals with limited ability to participate in social roles and activities were 95% less likely ($P < .001$) to report acceptable PsA activity levels than those who were able to participate in social roles and activities at a normal level (Table 3).

After adjusting for age, sex, and severity of PsO, statistically significant differences were found between individuals with unacceptable levels of PsA activity and those with acceptable levels of PsA activity for depression (2.56 [SD = 2.00] vs 0.80 [SD = 1.25], $P \leq .001$) and ability to participate in social roles and activities (mean t-scores = 44.56 [SD = 6.83] vs 55.46 [SD = 6.99], $P \leq .001$) (Table 4). In adjusted logistic regression models, individuals with likely depression were 86% less likely to report acceptable levels of PsA activity than those who were not experiencing likely depression (Table 3). Likewise, experiencing limited ability to participate in social roles and activities was associated with a 95% less likelihood of reporting acceptable PsA activity after adjusting for age, sex, and PsO severity (Table 3).

DISCUSSION

This cross-sectional study aimed to investigate the prevalence of unacceptable symptom states among patients with PsA in the United States and explore the association between an unacceptable symptom state and depression and impaired social interaction.

Our results suggest that nearly 60% of patients with PsA are living with an unacceptable symptom state. This number is considerably higher than reported by Lubrano et al (2020a)'s rheumatology center–based study using Patient Acceptable Symptom State as the PROM, citing that 32.3% of patients had an unacceptable symptom state. The potential discrepancy may be explained by a variety of factors, such as limited rheumatology-center patient access and utilization of Patient Acceptable Symptom State versus PsAID to assess symptom state. Moreover, our data reflect increased rates of acceptable symptom state among patients under specialized care for their PsA, which may further contribute to the discrepancy skewing toward symptom control.

Sex, skin disease severity, weight, and provider type managing psoriatic care were factors with significant association

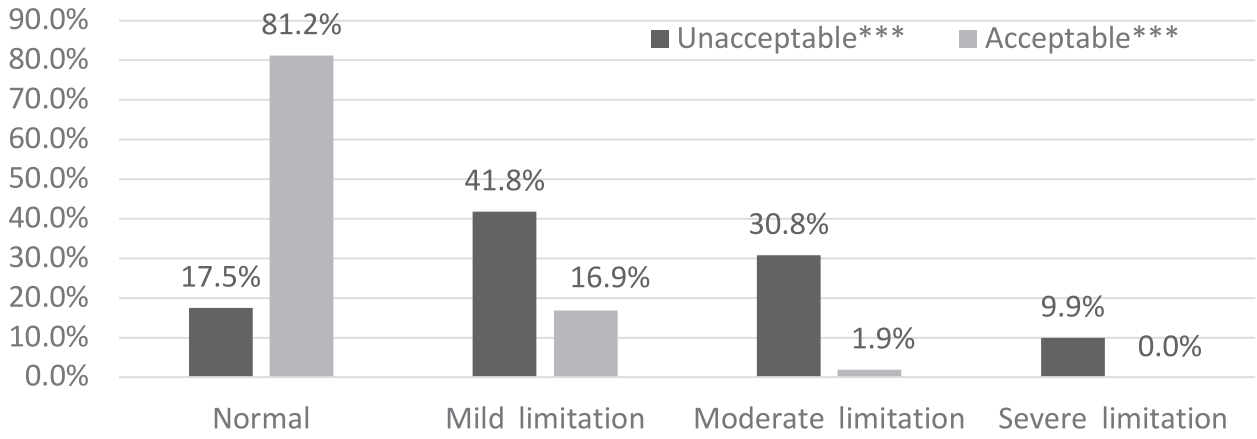

Figure 1. Ability to participate in social roles and activities by patient acceptable symptom state. Chi-square ***$P \leq .001$.

with symptom state. Specifically, patients who are women, have moderate-to-severe PsO, have a body mass index demonstrating overweight or obesity, and do not receive their primary PsA care from dermatologists/rheumatologists reported higher rates of unacceptable symptom state.

It is interesting to note that patients with unacceptable PsA symptoms have nearly identical rates of biologic use (unacceptable: 69.0%, acceptable: 70.2%) and more oral therapy use than those in the acceptable group (unacceptable: 46.1%, acceptable: 35.1%). Further exploration into specific treatment regimens of both groups may elucidate the discrepancy in symptom control and may better direct treatment optimization.

Among all respondents, 32.1% indicated a likelihood of being depressed. It is important to note that this is considerably higher than the United States population estimates from the same time period using the PHQ-2 (6.5%) (Terlizzi and Schiller, 2019). In addition, patients with an unacceptable symptom state reported having higher rates of depression than patients with an acceptable symptom state. Although depression is a well-known comorbidity of PsA, the cause-and-effect relationship between PsA and depression is difficult to decipher. Major depressive disorder has been found to significantly increase the risk for development of PsA in patients with PsO (Mathew and Chandran, 2020). There is compelling evidence to suggest the role of inflammation in the pathophysiology linking depression and PsA, such as increase in similar proinflammatory cytokines profiles in both conditions (Mathew and Chandran, 2020). Our results demonstrate that patients with PsA in unacceptable control have an increased rate of depression, which may serve to support inflammatory-driven hypotheses linking the conditions.

Diminished social participation was seen in patients with an unacceptable symptom state compare with patients with an acceptable symptom state. Our results show that 82.5% of patients with unacceptable levels of disease activity experienced at least mild limitations in their ability to participate in social roles and activities. Activity and participation are among the most commonly cited disabilities among patients with PsA, underscoring the importance of this domain in patient perspective (Gudu et al, 2017).

The increased rates of depression and increased limitations in social participation seen among patients with unacceptable symptom states highlights the significance of PsA disease impact on patient function and QOL. Thus, it remains of crucial importance to optimize disease control to improve both long-term and short-term patient outcomes.

Table 3. Impact of Depression and Limitations in Ability to Participate in Social Roles and Activities on Achieving Acceptable PsA Symptom State

Characteristic	OR	95% CI	*P*-Value
Univariate models			
Depression likely	0.12	0.08–0.18	<.001
Limited ability to participate in social roles and activities	0.05	0.03–0.07	<.001
Multivariate models			
Model number 1: depression likely	0.14	0.09–0.21	<.001
Age	1.00	0.98–1.01	.831
Male	2.48	1.73–3.55	<.001
Moderate–severe psoriasis	0.55	0.38–0.79	.001
Model number 2: limited ability to participate in social roles and activities	0.05	0.03–0.08	<.001
Age	1.01	0.99–1.03	.123
Male	1.61	1.05–2.46	.027
Moderate–severe psoriasis	0.58	0.38–0.88	.010

Abbreviations: CI, confidence interval; PsA, psoriatic arthritis.

Table 4. Differences in Social Activity and Depression among Patients in Acceptable Versus Unacceptable Symptom State

Characteristic	Unacceptable PsA	Acceptable PsA
Ability to Participate in Social Roles and Activities (PROMIS sf-4a)		
Unadjusted (SD)	40.78 (±6.91)[1]	52.16 (±6.90)[1]
Age, sex, and PsO severity adjusted (SD)	44.56 (±6.83)[1]	55.46 (±6.99)[1]
Depression (PHQ-2)		
Unadjusted (SD)	2.70 (±2.00)[1]	0.82 (±1.24)[1]
Age, sex, and PsO severity adjusted (SD)	2.56 (±2.00)[1]	0.80 (±1.25)[1]

Abbreviations: PHQ-2, Patient Health Questionnaire 2; PsA, psoriatic arthritis; PsO, psoriasis.
[1]$P \leq .001$.

Limitations

Low survey completion rate and a sample consisting of individuals engaged with a patient advocacy organization may contribute to selection bias. Past studies suggest that NPF members may have more severe disease, be more affluent, and be more aware of the treatment options available to manage their PsO than the general psoriatic disease patient population (Nijsten et al, 2005). In addition, our participant sample population demonstrated increased proportions of female sex and White or Caucasian race compared with general population estimates (see Table 1 footnote). Moreover, our participating patient population demonstrated increased prevalence of PsA compared with the general PsA prevalence among people with PsO (30%). This discrepancy is due to the sampling framework used by the NPF annual survey, which balances participants on the basis of the presence of PsA so that the resulting dataset will be comprised of roughly 50% of participants with PsA and 50% with only PsO, to increase the number of participants with PsA. In addition, some of our data results are consistent with previously established patterns indicating reduced persistence of biologics in older patients, particularly in women with increased comorbidities, tobacco use, depression, and chronic pain (Haddad et al, 2021; Rida et al, 2023; Stober et al, 2018). In this demographic, fibromyalgia frequently overlaps PsA, further potentially confounding data.

The study reveals that approximately 60% of patients with PsA in the United States continue to experience significant symptoms, leading to notable declines in social activity and an increased prevalence of depression. Although previous suggestions for dermatologists to be more proactive in screening for PsA holds merit, it is crucial to shift the focus from diagnosis to control. Our findings suggest that treatment monitoring by a dermatologist or rheumatologist was associated with an increased likelihood of being in a patient acceptable symptom state. Nevertheless, many of our patients were already under dermatological and/or rheumatological management, with persistence of their uncontrolled symptoms. Perhaps the incorporation of validated PsA health impact measurement instruments, such as the PSAID-9, into clinical care may be beneficial to aid treatment-to-target strategies. The PSAID-9 is conveniently available free of charge on the Group for Research and Assessment of Psoriasis and Psoriatic Arthritis app. In addition, incorporating tools such as PHQ-2 and triggers to PHQ-9 for depression assessment at routine clinic visits may be considered, given the high prevalence of depression among the PsA patient population. Frequent barriers to routine PHQ-2/PHQ-9 utilization include concerns over how to address the self-harm question, what to do should someone indicate thoughts of self-harm, and the lack of a referral network should a patient screen positive for depression. These may be barriers to a single, private dermatology practice but may certainly be addressed through clear protocols, established referral networks, patient education, and collaboration with community services. Moreover, providers in a hospital network or an academic medical center may leverage the extensive resources available within their affiliated organizations to overcome these challenges. Although the incorporation of validated instruments into clinical practice is not without its own obstacles, these validated instruments may prompt the necessary urging for more aggressive referral and treatment strategies. As such, the establishment of streamlined protocols to facilitate their integration into clinical practice would offer considerable benefit to patients. Both PsA and depression necessitate a more proactive and comprehensive screening and management approach across the various specialties managing psoriatic care.

MATERIALS AND METHODS

The NPF surveyed a random, stratified sample of individuals with psoriatic disease in the United States from the NPF's constituent database. Patients were active members of the NPF within the past 2 years, aged >18 years, carried a self-reported diagnosis of PsO or PsA, and had an active email address or phone number. A total of 23,340 patients were invited to participate in an online or telephone survey between October 16, 2019 and November 11, 2019.

Ethics approval was obtained from the genetic alliance institutional review board (protocol number NPF-ASP-2019). Written informed consent was obtained from all subjects. The survey incorporated validated PROMs to assess BSA, depression (PHQ-2), social participation (PROMIS Ability to Participate in Social Roles and Activities), and PsA-specific QOL (PsAID-9).

Only survey respondents with PsA who completed the PsAID-9 (n = 801) were included in this study. Pairwise deletion was used to handle missing data. These respondents were grouped on the basis of their PsAID scores. Individuals with a PsAID score ≤4 were classified as having acceptable level of disease impact, and individuals with a PsAID score >4 were classified as having unacceptable level of disease impact. These cutoff values for acceptable and unacceptable level of PsA disease impact have been established and validated by previous studies (Lubrano et al., 2020a, 2020b; Gossec et al., 2014).

Severity of PsO was defined by BSA as reported by patients using the Patient Report of Extent of Psoriasis Involvement, a validated PROM for assessing BSA (Dommasch et al, 2010). On the basis of reported BSA, participants were classified as having mild-to-no PsO (BSA <3%) or moderate-to-severe PsO (BSA ≥3%).

Depression was assessed utilizing the PHQ-2, a brief, validated PROM to assess depression. PHQ-2 scores were calculated in a range of 0−6, with scores ≥3 used to indicate depression is likely and scores <3 used to indicate depression is not likely (Kroenke et al, 2003).

Social participation was assessed using the PROMIS Ability to Participate in Social Roles and Activities. Survey participant responses were scored and interpreted in accordance with the scoring instructions established by the PROMIS workgroup (Cella et al, 2019). *t*-scores were calculated for comparison with a normative population to assess limitations in ability to participate in social roles. For logistic regression analyses, ability to participate in social roles and activities scores were recoded dichotomously to indicate normal ability to participate in social roles and activities and limitations with ability to participate in social roles and activities.

Descriptive statistics were generated to establish the prevalence of unacceptable symptom state, depression, and social participation abilities in a real-world population of patients with PsA. Chi-square tests were used to assess differences in unacceptable symptom state, depression, and social participation abilities on the basis of demographic characteristics. Analysis of covariance was conducted to assess the impact of unacceptable symptom state on the likelihood of experiencing depression and limited social participation ability while controlling for age, sex, and PsO severity. Linear regression models were conducted to generate adjusted mean differences between groups. Descriptive statistical analyses and chi-square tests were conducted with Statistical Package for the Social Sciences, version 26, and ANOVA and logistic regression analyses were conducted in STATA SE, version 9.

ETHICS STATEMENT

This report was reviewed internally and approved by all authors for integrity, accuracy, and consistency with scientific and ethical standards. This study was approved by the genetic alliance institutional review board (protocol number NPF-ASP-2019). Written, informed consent was provided by all subjects.

DATA AVAILABILITY STATEMENT

The datasets used and/or analyzed during this study are available from ggondo@psoriasis.org on reasonable request.

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CONFLICT OF INTEREST

GCG and SJB are employees of the National Psoriasis Foundation. ABG has received honoraria as an advisory board member and consultant for Amgen, AnaptypsBio, Avotres Therapeutics, Boehringer Ingelheim, Bristol-Myers Squibb, Dice Therapeutics, Eli Lilly, Janssen, Novartis, Sanofi, UCB, and Xbiotech and has received research/educational grants from AnaptypsBio, Moonlake Immunotherapeutics AG, Novartis, Bristol-Myers Squibb, and UCB Pharma (all paid to Mount Sinai School of Medicine). JFM is a consultant and/or investigator for Amgen, Boehringer Inhelheim, Bristol-Myers Squibb, Abbvie, Dermavant, Eli Lilly, Incyte, Novartis, Janssen, UCB, Sanofi-Regeneron, Sun Pharma, Biogen, Pfizer, and Leo Pharma LP-C has received research funding from the Group for Research and Assessment of Psoriasis and Psoriatic Arthritis. The remaining authors state no conflict of interest.

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AUTHOR CONTRIBUTIONS

Conceptualization: GCG, SJB, ARO-B, LP-C, JFM, ABG; Data Curation: GCG, SJB, ARO-B, ATK; Formal Analysis: GCG, SJB, ARO-B, ATK; Investigation: MPZ, GCG, SJB, ARO-B, ATK, LP-C, JFM, ABG; Methodology: GCG, SJB, ARO-B, ATK; Project Administration: GCG, JFM, ABG; Resources: GCG, SJB, ARO-B, LP-C, JFM, ABG; Software: GCG, SJB; Supervision: GCG, ARO-B, LP-C, JFM, ABG; Validation: GCG, SJB, ARO-B, ATK; Visualization: CGC, SJB, ARO-B, ATK; Writing − Original Draft Preparation: MPZ; Writing − Review and Editing: MPZ, LP-C, HH, GCG, ATK, SJB, ZL, JFM, ABG

DECLARATION OF GENERATIVE ARTIFICIAL INTELLIGENCE (AI) OR LARGE LANGUAGE MODELS (LLMs)

The author(s) did not use AI/LLM in any part of the research process and/or manuscript preparation.

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