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ORIGINAL PAPER

Comparison of physical and mental functioning among moderate-to-severe psoriasis patients on biologic versus oral therapy

Nicole Salame[1] · Nazanin Ehsani-Chimeh[2] · April W. Armstrong[3]

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Abstract

With the extensive variety of available treatments for psoriasis, it is paramount that clinicians understand the differences between therapies. A critical literature gap exists regarding the effects of different systemic therapies on physical and mental functioning in the US psoriasis population. We sought to compare the impact of biologic versus oral therapy on measures of physical and mental functioning among US adults with moderate-to-severe psoriasis. We performed a nationwide, cross-sectional study of 2,431,282 (weighted) (183 non-weighted) US adults with psoriasis on biologic or oral therapy using the 2003–2015 Medical Expenditure Panel Survey (MEPS). Physical and mental functioning were measured with the Short Form-12 version 2 (SF-12v2) Physical Component Summary (PCS) and Mental Component Summary (MCS), respectively. The mean PCS score among patients on biologic therapy was significantly higher than that of patients on oral therapy (46.25 [95% CI 43.91–48.59] versus 42.39 [95% CI 41.05–43.73]; $P < 0.01$). The mean MCS score among patients on biologic therapy was also significantly higher than that of patients on oral therapy (52.46 [95% CI 50.51–54.41] versus 50.19 [95% CI 49.00–51.38]; $P < 0.05$). Based on adjusted multiple linear regression, biologic therapy was associated with a significantly greater increase in measures of physical functioning ($P < 0.05$) and mental functioning ($P < 0.001$) as compared to oral therapy. In conclusion, clinicians need to account for physical and mental health when making treatment decisions. Biologic therapy is associated with significantly greater increases in measures of physical and mental functioning when compared to oral therapy in the US adult psoriasis population.

Keywords Psoriasis · Biologics · Oral systemics · Systemic therapies · Mental functioning · Physical functioning

Introduction

Psoriasis is a chronic inflammatory skin disease with high prevalence and profound morbidity [19]. The chronicity and unpredictable course of psoriasis have been reported among the most troubling features of the disease [12]. Nearly 60% of psoriasis patients report major detriments to quality of life due to their psoriasis, regardless of disease severity [25]. Within the quality of life domain, mental health impairments are often the most profound. Symptoms of depression and anxiety have been estimated to affect 30% of psoriasis patients [10]. Additionally, comorbid mental illness has been associated with poor treatment adherence [20].

In addition to psychosocial health, psoriasis has important negative implications for physical functioning. Disability associated with psoriasis has been reported to be as high as those of patients with heart disease, hypertension, and cancer [21]. Up to 42% of psoriasis patients develop psoriatic

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✉ April W. Armstrong
armstrongpublication@gmail.com

Nicole Salame
nsalame@uci.edu

Nazanin Ehsani-Chimeh
nehsani@usc.edu

[1] University of California, Irvine School of Medicine, 1001 Health Sciences Rd, Irvine, CA 92617, USA

[2] Department of Dermatology, Keck School of Medicine of University of Southern California, 1441 Eastlake Ave, NTT3427, Los Angeles, CA, USA

[3] Department of Dermatology, Keck School of Medicine of University of Southern California, 1975 Zonal Avenue, KAM 510, MC 9034, Los Angeles, CA, USA

arthritis [15], an inflammatory arthritis with irreversible and disabling joint damage. Comorbid psoriatic arthritis contributes to psychological decrements in psoriasis [26]. Furthermore, the progressive nature of psoriatic arthritis leads to an increase in number of joints affected over time [17]. The associated physical disability caused by psoriatic arthritis ultimately reduces social participation and work productivity [3].

It is important that clinicians treating psoriasis patients utilize measures of physical and mental functioning when making treatment decisions. Instruments that measure physical and mental functioning include the Short Form-12 (SF-12), a generic measure that has been validated in the psoriatic population [16]. Measuring physical functioning facilitates therapeutic optimization to prevent further disability [15]. Additionally, measuring mental functioning enables clinicians to identify and actively manage patients with psychological impairments. Thus, measures of physical and mental functioning are paramount to the management of psoriatic disease.

To date, no large epidemiologic studies have compared the effects of different systemic therapies on physical and mental functioning in a representative US psoriasis population. With the large array of available therapeutic options in psoriasis, it is important to examine the difference between therapies regarding their impact on physical and mental health. We sought to compare the impact of biologic versus oral therapy on measures of physical and mental functioning among US adults with moderate-to-severe psoriasis.

Materials and methods

Data source and population selection

This study utilized cross-sectional, de-identified data from the 2003–2015 Household Component of the Medical Expenditure Panel Survey (MEPS), a national survey of the non-institutionalized US population sponsored by the Agency for Health Care Research and Quality (AHRQ) [7]. Each year, MEPS implements a stratified, multi-staged area probability design to sample approximately 15,000 new US households from a pool of those that completed the previous year's National Health Interview Survey (NHIS) [8]. Surveys are administered in a panel design consisting of five rounds of computer-assisted personal interviews (CAPI) that span two years [1]. Surveys gather information on health status, socio-demographic characteristics, healthcare utilization, and healthcare expenditures with a response rate between 57 and 78% [1].

The study population included all adults (≥ 18 years of age) with a reported diagnosis of psoriasis who were treated with biologic or oral therapy and completed the Short Form-12 version 2 (SF-12v2) during the survey period. Using the Medical Conditions data file, we applied the International Classification of Diseases, Ninth Revision (ICD-9) code 696 to identify patients with a diagnosis of psoriasis. Using the Prescribed Medicines data file, we identified patients with a diagnosis of psoriasis who were undergoing treatment with biologic or oral therapy. Using the Full-Year Consolidated data file, we acquired SF-12v2 data. Patients met criteria for moderate-to-severe psoriasis if they reported a diagnosis of psoriasis and treatment with biologic or oral therapy during the survey period.

This study was evaluated and determined to be exempt by the Institutional Review Board at the University of Southern California (IRB#HS-IIR00002254). The publicly available MEPS database provided all de-identified patient information for this study. MEPS respondents with missing data were excluded from the analysis.

Variables

Dependent variables were measures of physical functioning, assessed by the SF-12v2 Physical Component Summary (PCS), and mental functioning, assessed by the SF-12v2 Mental Component Summary (MCS). The independent variable (predictor) was treatment with either biologic or oral therapy.

We adjusted for socio-demographic and clinical covariates that could obscure the relationship between treatment and mental or physical functioning. Socio-demographic covariates included self-reported age, gender, race, ethnicity, marital status, employment status, and poverty level category. Clinical covariates included the presence of cognitive limitations, social limitations, and comorbidities. We considered cognitive limitations to be present if patients reported confusion or memory loss, problems making decisions, or the requirement of supervision for safety. We adjusted for comorbidities using the Charlson Comorbidity Index (CCI) [5], with the exclusion of depression due to its collinearity with mental health functioning in the regression model.

Short form-12 version 2 (SF12v2)

The SF-12 is a 12-item, internationally recognized and validated generic measure of health that is derived from the Short Form-36 (SF-36) Health Survey [28–30]. It consists of two subscales: the Physical Component Summary (PCS) and Mental Component Summary (MCS). The SF-12 version 2 was released in 2002 as an improved version of the previous SF-12 version 1 [28].

The PCS consists of 6 items that assess four domains of physical functioning: physical function, general health, bodily pain, and role limitations due to physical health [30]. Items on physical function, general health, and bodily pain are administered on a 5-point ordinal scale from 1 (*excellent* or *all of the time*) to 5 (*poor* or *none of the time*). Items on role limitations

due to physical health are administered on a dichotomous scale (*yes* or *no*). The PCS has demonstrated high internal consistency, test–retest reliability, and construct validity in the MEPS database [6].

The MCS consists of 6 items that assess four domains of mental functioning: social function, mental health, vitality, and role limitations due to emotional health [30]. Items on social function, mental health, and vitality are administered on a 5-point ordinal scale from 1 (*excellent* or *all of the time*) to 5 (*poor* or *none of the time*). Items on role limitations due to emotional health are administered on a dichotomous scale (*yes* or *no*). The MCS has demonstrated high internal consistency, moderate test–retest reliability, and moderate construct validity in the MEPS database [6].

For both subscales, a weighted global scored (range 0–100) is calculated according to a published algorithm [29]. Higher scores on the PCS and MCS subscales indicate greater physical health and mental functioning, respectively. A global score of 50 on either subscale is considered the average score for the general US populations [28].

Analysis

We corrected for standard errors from clustering and primary sampling units to account for the MEPS survey design. We applied person-level sampling weights to account for unequal selection probabilities and non-response rates. All statistical analyses were conducted using STATA version 13.0 (StataCorp LP, College Station, TX).

We divided the weighted study population into two treatment groups: biologic therapy and oral therapy. We applied descriptive statistics to tabulate each treatment group's age, gender, race, ethnicity, marital status, poverty level category, cognitive limitations, social limitations, employment status, and calculated CCI. We performed univariate analyses to test the null hypothesis that there were no differences in socio-demographic and clinical characteristics between the treatment groups.

We conducted independent analyses for the PCS and MCS subscales. We performed univariate analyses testing the null hypothesis that there were no differences in mean subscale scores between patients on biologic versus oral therapy. Additionally, we performed an adjusted multivariable linear regression to investigate the relationship between physical or mental functioning and psoriasis treatment using the following model:

$$\begin{aligned} Y = {} & \beta^{\circ} \times (\text{Treatment}) + \beta 1 \times (\text{Age}) + \beta 2 \times (\text{Gender}) \\ & + \beta 3 \times (\text{Race}) + \beta 4 \times (\text{Ethnicity}) \\ & + \beta 5 \times (\text{Marital Status}) + \beta 6 \times (\text{Employment Status}) \\ & + \beta 7 \times (\text{Poverty Level Category}) \\ & + \beta 8 \times (\text{Cognitive Limitations}) \\ & + \beta 9 \times (\text{Social Limitations}) \\ & + \beta 9 \times (\text{CCI}), \end{aligned}$$

where Y represents PCS or MCS scores, and β° indicates the magnitude of the change in PCS or MCS scores associated with biologic or oral therapy. $\beta 1$–$\beta 9$ represent the magnitude of change in PCS or MCS scores associated with the respective parenthetical covariates. $P \leq 0.05$ was established a priori as statistically significant, and F-adjusted mean residual goodness-of-fit values are reported.

Results

Population descriptive analyses

A total of 2,457,775 (weighted) (185 non-weighted) US adults with moderate-to-severe psoriasis on biologic or oral therapy was identified from the pooled 2003–2015 MEPS. Approximately, 1% (26,493 weighted, 2 non-weighted) of these patients was excluded from the analysis due to missing data. All missing data pertained to the variable, *cognitive limitations*. A comparison of the socio-demographic and clinical characteristics of the original population with missing data and the analyzed population with complete data is detailed in Online Resource 1.

A total of 2,431,282 (weighted) (183 non-weighted) US adults with moderate-to-severe psoriasis were included in the final analysis. Among these patients, 803,107 (weighted) (56 non-weighted) were on biologic therapy and 1,628,175 (weighted) (127 non-weighted) were on oral therapy. The mean (SEM) age was 55.96 (1.16) years, and females comprised 52% of the population. The socio-demographic and clinical characteristics of each treatment group are summarized in Table 1. Score distributions for the PCS and MCS subscales are presented for each treatment in Table 2. Adjusted multivariable linear regression results for the PCS and MCS subscales are detailed in Table 3.

Physical component summary (PCS)

The mean (95% CI) PCS score was 43.67 (42.30–45.03). Patients on biologic therapy had a mean (95% CI) PCS score of 46.25 (43.91–48.59). Patients on oral therapy had a mean (95% CI) PCS score of 42.39 (41.05–43.73). The mean PCS score for patients on biologic therapy was significantly lower than the mean PCS score for patients on oral therapy ($P < 0.01$) (Table 2).

Based on adjusted multivariable linear regression, biologic therapy was associated with a significantly greater increase in PCS score as compared to oral therapy ($F(17,6) = 764.26$, $p < 0.001$, $R^2 = 0.4425$). Specifically, biologic therapy was associated with a 1.928-point increase in PCS score ($P < 0.05$) (Table 3). Unadjusted linear regression analysis also revealed a significant increase in PCS score ($\beta = 3.855$, $P < 0.01$) associated with biologic therapy as compared to oral therapy (F (1, 22) = 13.03, $P < 0.01$, $R^2 = 0.0198$).

Table 1 Socio-demographic and clinical characteristics of adults with moderate-to-severe psoriasis on biologic or oral therapy from the MEPS

Characteristic	Biologic therapy (weighted $n = 803,107$)	Oral therapy (weighted $n = 1,628,175$)	*P* value
Age, mean (SEM) years	50.15 (1.55)	58.83 (1.17)	<0.001[a]
Gender, female *n* (%)	305,424 (38)	960,616 (59)	0.042[b]
Unemployed, *n* (%)	230,545 (29)	706,405 (43)	0.133[b]
Race, *n* (%)			
White	718,570 (90)	1,505,671 (92)	<0.001[b]
Asian, Native Hawaiian, or Pacific Islander	35,383 (4)	41,924 (3)	0.77[b]
Black	21,968 (3)	44,704 (3)	0.69[b]
Multiple races reported	27,186 (3)	26,821 (1)	0.88[b]
American Indian or Alaskan Native	0 (0)	9055 (1)	–
Ethnicity, Hispanic *n* (%)	49,479 (6)	123,304 (8)	0.63[b]
Marital status, married *n* (%)	569,882 (71)	955,715 (59)	0.005[b]
Cognitive limitations, *n* (%)[c]	56,687 (7)	125,356 (8)	0.80[b]
Social limitations, *n* (%)	106,236 (13)	259,260 (16)	0.35[b]
Poverty level category, *n* (%)[d]			
Poor	29,955 (4)	88,199 (6)	0.73[b]
Near poor	14,835 (2)	90,947 (6)	0.89[b]
Low income	108,432 (13)	168,702 (10)	0.73[b]
Middle income	306,085 (38)	430,541 (26)	0.19[b]
High income	343,800 (43)	849,786 (52)	0.047[b]
CCI, mean (95% CI)	1.36 (1.16–1.56)	1.52 (1.40–1.64)	0.13[a]
Treatment, *n* (%)			
Etanercept	556,205 (69)	–	
Adalimumab	204,996 (26)	–	
Certolizumab pegol	41,906 (5)	–	
Oral systemic steroids	–	1,114,841 (68)	
Methotrexate	–	358,717 (22)	
Sulfasalazine	–	96,201 (6)	
Acitretin	–	20,136 (1)	
Mycophenolate mofetil	–	14,544 (1)	
Leflunomide	–	12,789 (1)	
Azathioprine	–	10,947 (1)	

MEPS Medical Expenditure Panel Survey, *SEM* Standard Error of the Mean, *CCI* Charlson Comorbidity Index, *CI* Confidence Interval

[a]2-tailed *t* test of the differences between US adults with moderate-to-severe psoriasis on biologic versus oral therapy

[b]χ^2 test of the differences between US adults with moderate-to-severe psoriasis on biologic versus oral therapy

[c]1% of the original study population had incomplete data pertaining to cognitive limitations and were excluded from analysis. See the Supplemental Online Material for a comparison of the characteristics of our study population with complete data and the original population with incomplete data

[d]Poverty level category, identified as percent of federal poverty level (FPL) and reported as follows: poor (≤100% of FPL), near poor (100% to <125% of FPL), low income (125% to <200% of FPL), middle income (200% to <400% of FPL), and high income (≥400% of FPL)

Mental component summary (MCS)

The mean (95% CI) MCS score was 50.94 (49.93–51.95). Patients on biologic therapy had a mean (95% CI) MCS score of 52.46 (50.51–54.41). Patients on oral therapy had a mean (95% CI) MCS score of 50.19 (49.00–51.38). The mean MCS score for patients on biologic therapy was significantly lower than the mean MCS score for patients on oral therapy ($P < 0.05$) (Table 2).

Based on adjusted multivariable linear regression, biologic therapy was associated with a significantly greater increase in MCS score as compared to oral therapy

Table 2 Score distributions for measures of physical and mental functioning among adults with moderate-to-severe psoriasis on biologic or oral therapy from the MEPS

Instrument	Biologic therapy (weighted $n=803,107$)	Oral therapy (weighted $n=1,628,175$)	P value
SF12v2 PCS			
Mean (95% CI) score	46.25 (43.91–48.59)	42.39 (41.05–43.73)	0.002[a]
SF12v2 MCS			
Mean (95% CI) score	52.46 (50.51–54.41)	50.19 (49.00–51.38)	0.040[a]

MEPS Medical Expenditure Panel Survey, *SF12v2* Short Form-12 version 2, *PCS* Physical Component Summary, *MCS* Mental Component Summary, *CI* Confidence Interval

[a]2-tailed t tests of the differences between US adults with moderate-to-severe psoriasis on biologic versus oral therapy

($F(17,6)=331.91$, $P<0.001$, $R^2=0.2492$). Specifically, biologic therapy was associated with a 3.088-point increase in MCS score ($P<0.001$) (Table 3). Unadjusted linear regression analysis also revealed a significant increase in MCS score ($\beta=2.270$, $P<0.05$) associated with biologic therapy as compared to oral therapy ($F(1, 22)=4.75$, $P<0.05$, $R^2=0.0113$).

Discussion

In this nationwide, epidemiologic study of 2,431,282 adults (weighted) (183 non-weighted) with moderate-to-severe psoriasis, patients on biologic therapy exhibited better average physical and mental functioning, as measured by mean SF-12 PCS and MCS scores, compared to those on oral therapy. Specifically, our study presented novel findings that biologic therapy was associated with a significantly greater increase in measures of physical and mental functioning as compared to oral therapy.

The minimal clinical important difference (MCID), defined as the smallest change considered clinically important to patients, has not been established for the SF-12 in the psoriasis population. However, the MCID derived from studies of patients with a comparable level of disability, such as the heart failure population [21], may be referenced while recognizing that the two clinical entities are distinct. In a study of patients with heart failure, the MCID for the PCS and MCS was estimated to be 1.3 and 2.3, respectively [4]. Our study found that biologic therapy was associated with a 1.982-point and 3.088-point increase in measures of physical and mental functioning, respectively, which lies above the level that patients with a similar degree of disability consider clinically meaningful. Further studies are needed to determine the MCID for the SF-12 subscales in the psoriasis population.

In the psoriasis population, decrements in physical functioning are a consequence of both psoriasis' comorbidities and anatomical location of lesions. Psoriasis patients suffer increased morbidity and mortality due to cardiovascular and inflammatory comorbidities [13, 31, 32]. Psoriatic arthritis is among the most disabling of these comorbidities with significant negative impact on work productivity [3]. In addition to comorbidities, anatomical location of lesions has a large impact on physical disability in the psoriasis population. Patients with palmoplantar [19] and nail psoriasis [9] report greater restrictions in daily activity compared to those with other disease variants. This study found that, as compared to oral therapy, biologic therapy is associated with significantly greater increases in physical functioning. These findings are highly informative for clinicians treating physical dysfunction in psoriasis, especially in patients with extensive comorbidities and palmoplantar or nail psoriasis.

Impairments in mental functioning among psoriasis patients manifest as severe psychological sequelae, potential suicidality, and social dysfunction [11, 24]. Fear of negative evaluation and social anxiety among psoriasis patients is reportedly higher than that of patients with atopic dermatitis, acne, and vitiligo [17, 24]. Social anxiety ultimately leads to social isolation and depression, which manifests as loss of vitality, apathy, and anhedonia [11]. This study found that, as compared to oral therapy, biologic therapy is associated with significantly greater increases in mental functioning. These findings have important clinical implications because choice of therapy may ultimately impact overall psychosocial wellbeing in psoriasis patients.

Though psoriasis independently impacts physical and mental health, compelling evidence also exists for an interplay between psychological distress and physical disease in psoriasis. Anxiety, depression, and perceptions of stigmatization contribute to psychological distress in psoriasis patients [11]. As a consequence of psychological distress, patients suffer a chronic, low-grade physical stress, which may manifest as psoriasis flares or recalcitrant disease [11]. The mechanism linking psychological distress and systemic inflammation in psoriasis is not well understood. Studies have supported a link between psychological distress and increased circulating inflammatory markers [14, 25]. Therefore, treating psoriasis with systemic therapies may reduce inflammation and ultimately improve both physical and mental functioning.

Table 3 Adjusted multivariable regression analyses of the association between treatment and measures of physical or mental functioning among adults with moderate-to-severe psoriasis

Independent variables	Dependent variables (Instruments)			
	PCS		MCS	
	β Coef. (95% CI)	*P* value	β Coef. (95% CI)	*P* value
Treatment				
Oral	1 [Reference]		1 [Reference]	
Biologic	1.928 (0.177 to 3.679)	0.032	3.088 (1.663 to 4.513)	< 0.001
Age	− 0.138 (-0.247 to − 0.029)	0.015	0.021 (− 0.036 to 0.077)	0.046
Gender				
Male	1 [Reference]		1 [Reference]	
Female	− 0.125 (− 2.425 to 2.176)	0.91	− 0.371 (− 2.159 to 1.418)	0.67
Race				
White	1 [Reference]		1 [Reference]	
Black	− 1.867 (− 3.898 to 0.165)	0.070	3.470 (1.741 to 5.198)	< 0.001
American Indian or Alaskan Native	− 13.805 (− 19.327 to − 8.284)	< 0.001	9.840 (4.076 to 15.604)	0.002
Asian, Native Hawaiian, or Pacific Islander	− 1.830 (− 5.195 to 1.535)	0.27	− 2.404 (-5.098 to 0.290)	0.078
Multiple races	− 13.877 (− 19.656 to − 8.098)	< 0.001	2.77 (− 0.143 to 5.691)	0.061
Ethnicity				
Non-Hispanic	1 [Reference]		1 [Reference]	
Hispanic	1.239 (− 1.172 to 3.650)	0.30	− 1.620 (− 4.202 to 0.961)	0.21
Marital Status				
Married	1 [Reference]		1 [Reference]	
Single, Widowed, Separated, or Divorced	2.690 (1.037 to 4.343)	0.003	1.848 (0.332 to 3.363)	0.019
Employment Status				
Employed	1 [Reference]		1 [Reference]	
Unemployed	− 8.962 (− 12.074 to − 5.850)	< 0.001	0.935 (− 0.826 to 2.696)	0.28
Poverty level category				
High income	1 [Reference]		1 [Reference]	
Middle income	− 3.332 (− 5.608 to − 1.056)	0.006	− 3.306 (− 5.360 to − 1.253)	0.003
Low income	− 3.773 (− 6.918 to − 0.629)	0.021	− 10.257 (− 13.029 to − 7.485)	< 0.001
Near poor	− 6.571 (− 12.702 to − 0.439)	0.037	− 4.105 (− 9.703 to 1.494)	0.14
Poor	− 3.936 (− 5.972 to − 1.901)	0.001	− 10.973 (− 14.224 to − 7.722)	< 0.001
Cognitive Limitations				
No Cognitive Limitations	1 [Reference]		1 [Reference]	
Cognitive limitations	− 3.908 (− 8.238 to 0.422)	0.075	4.256 (1.363 to 7.149)	0.006
Social Limitations				
No Social Limitations	1 [Reference]		1 [Reference]	
Social Limitations	− 8.671 (− 11.938 to − 5.404)	< 0.001	− 9.704 (− 11.488 to − 7.919)	< 0.001
CCI	0.810 (− 0.260 to 1.881)	0.131	1.172 (0.471 to 1.873)	0.002
Constant	55.973 (51.197 to 60.749)	< 0.001	50.207 (47.707 to 52.707)	< 0.001

PCS physical component summary, *MCS* Mental Component Summary, *CCI* Charlson Comorbidity Index

Because psoriasis requires long-term management, it is important to consider costs as one part of the therapeutic decision-making process. Economic analyses of medication costs often depend on the economic "perspective." That is, what may be costly to one party can be considered cost-saving to another party. As clinicians, we shall think beyond the costs to the health system or to individual patients; rather, we shall adopt the "societal" perspective and account for costs to all parties. Thus, studies focusing on economic analyses evaluating cost-effectiveness of biologics versus oral medications from a *societal* perspective will be particularly informative.

Due to the profound burden of psoriasis, it is critical that clinicians account for physical and mental health when

making treatment decisions. Clinicians may consider piloting measures such as the SF-12 in their clinical practice to identify patients who may benefit from biologic therapy. Alternatively, while the SF-12 acts as an abridged quality of life measure, researchers and clinicians may consider creating more feasible measures in the future for use in the clinical setting. Monitoring physical function in psoriasis and psoriatic arthritis facilitates early recognition of physical decrements and informs therapeutic modification to prevent further disability [15]. Furthermore, identifying and actively managing mental dysfunction in psoriatic disease may ultimately improve treatment adherence [23]. Moreover, addressing physical and mental limitations with patients may facilitate patient–provider relationships and foster shared treatment decision-making.

Limitations

Limitations of this study pertain to the use of the MEPS database. First, the top-coding of a proportion of prescription data by the AHRQ precluded identification of US adults treated with newer biologic therapies and few oral systemic therapies. Second, as with most studies involving large databases, there exists a risk of misclassification when ICD data is utilized. However, this risk was low for our study because the majority of prescribers of systemic therapies were dermatology providers. Third, the provision of 3-digit ICD-9 codes by the MEPS prevented subgroup analyses of the study population identified by the ICD-9 code, 696, which includes diagnoses of both psoriasis and psoriatic arthritis. Lastly, this is a cross-sectional study intended to evaluate the association between systemic therapies and measures of mental and physical functioning among patients with psoriasis. This study is not intended for the evaluation of causation.

Conclusion

From this nationally represented population of 2,431,282 adults (weighted) (183 non-weighted) with moderate-to-severe psoriasis, biologic therapy was associated with a significantly greater increase in measures of physical and mental functioning as compared to oral therapy. This study's findings are highly informative for dermatology providers treating patients with significant physical and mental dysfunction. Early identification and treatment of such dysfunction may delay further disability, improve treatment adherence, and facilitate patient–provider decision-making.

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Compliance with ethical standards

Conflict of interest Nicole Salame and Nazanin Ehsani-Chimeh declare that they have no conflict of interest. April W. Armstrong has no relevant financial conflict of interest; other disclosures include her role as an investigator, consultant, advisor, and/or speaker to AbbVie, Janssen, Lilly, Novartis, Sanofi, Regeneron, Leo, Science 37, Modmed, Pfizer, Ortho Dermatologics, and Modernizing Medicine.

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