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Increased severity of itching, pain, and scaling in psoriasis patients is associated with increased disease severity, reduced quality of life, and reduced work productivity

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**Original**

**Increased severity of itching, pain, and scaling in psoriasis patients is associated with increased disease severity, reduced quality of life, and reduced work productivity**

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**Abstract**

**Background:** Psoriasis patients report that this disease can impact on their health-related quality of life (HR-QoL) and work productivity. It is important to understand how this is influenced by the clinical characteristics of psoriasis such as symptom severity. Common symptoms include itching, pain, and scaling but the psychosocial impact these features have on patients is not well understood.

**Objective:** To explore the impact of psoriasis symptoms (itching, pain, and scaling) on HR-QoL and work productivity.

**Method:** Data were extracted from the Adelphi 2011 and 2013 Psoriasis Disease Specific Programmes – two real world surveys of US dermatologists and their psoriasis patients. HR-QoL was measured using the Dermatology Life Quality Index (DLQI) and EuroQOL 5-Dimension Health Questionnaire (EQ-5D). Work productivity loss was measured by the Work Productivity and Activity Impairment (WPAI) questionnaire. The impact of symptom severity (none, mild, moderate/severe) for itching, pain, and scaling on DLQI, EQ-5D, and WPAI scores were examined, controlling for differences in demographics and co-morbidities.

**Results:** Patient mean age was 44 years and 55% were male. Moderate/severe itching, pain, and scaling were experienced by 33%, 13%, and 41% of patients, respectively. Controlling for differences in demographics and co-morbidities, increased symptom severity was associated with reduced HR-QoL. Accordingly, EQ-5D scores decreased with itching severity (moderate/severe vs. none: -0.07; 95% confidence interval [CI] = -0.09, -0.04), whereas DLQI scores increased (moderate/severe versus none: 4.9; CI = 3.9, 5.9) (both p<0.05). WPAI scores increased with itching severity, indicating increased work productivity loss (moderate/severe versus none: 17.6, CI = 11.8, 23.5, p<0.05). The same pattern was observed for pain and scaling.

**Conclusions:** Among the patients studied, increased severity of psoriasis-related itching, pain, and scaling was associated with reduced health-related QoL and work productivity.

**Keywords:** Itching, pain, scaling, quality of life, psoriasis symptoms, work productivity

# Introduction

Psoriasis is a common, immune-mediated skin disorder that affects approximately 3% of adults in the US [1]. The percentage of body surface area (BSA) affected by psoriasis has traditionally been used to measure severity. However, it is well recognized that BSA alone does not fully capture the degree to which psoriasis impacts on an individual patient [2].

The presence of specific psoriasis symptoms is an important aspect of this disease and symptom severity may be independent of overall psoriasis severity [3, 4]. Patients typically describe itching (pruritus), skin pain/discomfort (including irritation, burning and stinging sensations), skin bleeding, and symptoms associated with the visual appearance of the skin such as inflammation, scaling/desquamation, and redness [5]. Itching, pain, and scaling have been reported as the most common symptoms [6]. Scaling is reported by over 90% of patients and is a hallmark feature of psoriasis [7]. Itching has been rated as the most troublesome symptom and is also highly prevalent – affecting between 60-85% of psoriasis sufferers [8, 11]. Skin pain is somewhat less common occurring in 25-40% of patients [11 - 12].

In addition to the physical manifestations of psoriasis, emotional problems, feelings of stigmatization, social impairment, and reduced work productivity have been observed [6, 13, 16]. The relationship between these health related quality of life (HR-QoL) issues and the physical aspects of the disease is not fully understood [17] and this has been suggested as an important avenue for future research [6]. Some studies have shown that itching [4, 10, 18] and skin pain/discomfort [19] are associated with reduced HR-QoL but scaling has largely been overlooked. In addition, although it is known that psoriasis is associated with work productivity loss [16], the impact of symptom severity on work productivity has not yet been evaluated. Finally, a further area warranting investigation is the relationship between symptom severity and overall disease severity as a linear relationship appears overly simplistic and results from previous studies have been mixed [3, 20, 21].

This analysis takes a comprehensive approach, examining not only the presence of psoriasis-related itching, pain, and scaling, but also their severity levels. The relationship between these symptoms with overall psoriasis disease severity (i.e. mild, moderate, and severe), HR-QoL and work productivity is explored.

## Methods

A retrospective database analysis was conducted using both physician and patient-reported data from the Adelphi Real World 2011 and 2013 Psoriasis Disease Specific Programmes® (DSPs; [22]). Psoriasis patients completed a Patient Self Completion (PSC) form and their dermatologist completed a Patient Record Form (PRF). The research was conducted in accordance with the US Health Insurance Portability and Accountability Act 1996 (HIPAA). Information about the study was described at the front of the PSC questionnaire and patients indicated their willingness to participate anonymously via a check box.

### Sample Selection

Physicians included were dermatologists who were actively involved in the treatment of psoriasis. They saw at least 10 psoriasis patients per month and had received their primary qualification as a physician between 1972-2010. The final sample comprised a geographical spread of 149 dermatologists who were primarily office based (92.6%). Patients were required to meet at least one of the following criteria at any point in their disease history: 1) had a BSA affected greater than 10%, 2) had moderate to severe psoriasis diagnosed by a physician, or 3) ever used systemic therapy (traditional or biologic). Each participating physician identified the next 7 consecutive consulting patients meeting the inclusion criteria. A PRF was completed and these patients were invited to fill in a PSC questionnaire on a voluntary basis. Patients who returned a completed PSC were included in this analysis.

### Study Measures

For each patient, dermatologists reported the severity of itching, pain, and scaling that the patient was currently experiencing. Response options were 'not currently affected', 'mild', 'moderate', or 'severe'. Physicians also provided a subjective indication of overall disease severity (mild, moderate or severe). In addition to these variables, demographic information and details of comorbid illnesses were reported by the physician for each patient.

Patients provided information collected via two validated HR-QoL instruments included within the PSC questionnaire (the EuroQoL 5 Dimension Health Questionnaire (EQ-5D), Dermatology Life Quality Index (DLQI) and also completed the Work Productivity Activity Index (WPAI) questionnaire.

## 1. EuroQoL 5 Dimension Health Questionnaire (EQ-5D)

The EQ-5D is a general measurement of health status indicate their “health today” in terms of no problems, some/moderate problems or extreme problems across five domains; mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. A single summary score is derived ranging from -0.59 to 1, in which 1 represents perfect health

## 2. Dermatology Life Quality Index (DLQI)

The dermatology specific DLQI covers six subdomains: symptoms and feelings, daily activities, leisure, work and school, personal relationships, and treatment [23]. Scores for each item range from 0–3 and are summed to create an overall DLQI score. Higher scores represent lower HR-QoL up to a maximum of 30. Individual subdomains are expressed as a percentage (0-100%).

## 3. Work Productivity Activity Index (WPAI)

The WPAI is an instrument for assessing work productivity over the previous week, covering four subdomains: the percentage of overall work impairment, work time missed (absenteeism), time impaired while at work (presenteeism), and activity impairment [24]. It is assessed on a scale of 0-100, with a higher score indicating a greater level of impairment/absence. Only the last subdomain (activity impairment) is relevant to patients who are not currently in paid employment.

## Statistical analysis

A small number of missing values within the questionnaires were anticipated owing to errors when completing the PRF/PSC as well as questions unanswered because of imperfect knowledge or preference. Where missing values were found for a particular variable, that patient was removed from all analyses involving that variable. However, these patients were still eligible for inclusion in other analyses.

Owing to relatively small numbers of patients in the moderate and severe groups, these patients were combined to create a moderate-to-severe group for each of the three symptoms. Patient demographics, overall disease severity (mild, moderate, and severe), comorbidities, and EQ-5D, DLQI, and WPAI scores were compared between symptom severity groups (none, mild, moderate-to-severe) for psoriasis-related itching, pain, and scaling. Means and standard deviations (SDs) were reported for numeric or ordinal variables (age, weight, years since diagnosis, % BSA affected, and mild, moderate, and severe overall disease) and between-group differences were assessed with Kruskal-Wallis and Mann-Whitney tests. For categorical variables (gender, ethnicity, body mass index [BMI] category), the percentage of patients was reported and Chi-Squared tests were used to assess between-group differences.

Multiple ordered logistic regression was employed to examine the relationship between the severity of psoriasis-related itching, pain, and scaling (none, mild, moderate-to-severe) and psoriasis overall disease severity (mild, moderate, severe). Multiple linear regression explored the impact of symptom severity for itching, pain, and scaling on EQ-5D, DLQI, and WPAI scores. All regression analyses controlled for demographics (age, gender, ethnicity, BMI) and comorbidities (possible psoriatic arthritis, hypertension, elevated cholesterol, anxiety, depression, and diabetes). Statistical significance was set at 0.05 and all analyses were performed in STATA® statistical software version 13.1 (StataCorp, 2013. Stata statistical software: Release 13. College Station, TX, StataCorp LP).

## Results

### Demographics

Data reported here are from the 700 patients who also returned a PSC questionnaire. Table 1 presents the patient demographic characteristics by symptom severity. Of the total patient sample, 73.6%, 32.0%, and 82.4% of the patients were currently experiencing psoriasis-related itching, skin pain, and scaling, respectively. Approximately one-third of patients experienced moderate-to-severe itching and scaling, whereas 13.1% of patients had moderate-to-severe pain. The majority of the patients (87.1%) were Caucasian with a mean age of 44 years. On average, patients weighed 78.9Kg, with 40.3% being overweight ( $>25$  BMI  $\leq 30$ ) and a further 23.6% being obese (BMI  $>30$ ) [25]. The mean number of years since diagnosis for the total sample was 5.8. The mean percentage of BSA affected was 9.8% overall, which increased significantly among patients with worse symptom severity for psoriasis-related itching, pain, and scaling.

Table 1: Patient Demographics

|   | Total<br>N=700 | Itching<br>N=697          |                           |                                     | Pain<br>N=687             |                           |                                    | Scaling<br>N=697          |                           |                                     |
|---|----------------|---------------------------|---------------------------|-------------------------------------|---------------------------|---------------------------|------------------------------------|---------------------------|---------------------------|-------------------------------------|
|   |                | None<br>(n=184;<br>26.4%) | Mild<br>(n=284;<br>40.7%) | Mod/<br>Severe<br>(n=229;<br>32.9%) | None<br>(n=467;<br>68.0%) | Mild<br>(n=130;<br>18.9%) | Mod/<br>Severe<br>(n=90;<br>13.1%) | None<br>(n=123;<br>17.6%) | Mild<br>(n=291;<br>41.8%) | Mod/<br>Severe<br>(n=283;<br>40.6%) |
| <b>Age (years), mean (SD)</b>           | 44.1<br>(15.6) | 44.6<br>(15.5)            | 44.4<br>(15.4)            | 43.1<br>(16.1)                      | 42.9<br>(15.5)            | 44.1<br>(15.4)            | 49.3*<br>(15.5)                    | 42.2<br>(15.0)            | 44.1<br>(14.7)            | 44.9<br>(16.8)                      |
| <b>Female n (%)</b>                     | 315<br>(45.1)  | 78<br>(42.6)              | 123<br>(43.3)             | 114<br>(49.8)                       | 207<br>(44.4)             | 59<br>(45.4)              | 47<br>(52.2)                       | 53<br>(43.4)              | 130<br>(44.7)             | 132<br>(46.6)                       |
| <b>Caucasian n (%)</b>                  | 603<br>(87.1)  | 155<br>(84.7)             | 246<br>(88.5)             | 201<br>(88.2)                       | 407<br>(87.9)             | 110<br>(86.6)             | 78<br>(87.6)                       | 114<br>(93.4)             | 246<br>(85.7)             | 241<br>(86.1)                       |
| <b>Weight, Kg mean (SD)</b>             | 78.9<br>(19.5) | 78.3<br>(16.9)            | 79.5<br>(20.4)            | 78.5<br>(20.4)                      | 77.7<br>(18.9)            | 80.8<br>(19.4)            | 81.3<br>(21.4)                     | 79.9<br>(19.0)            | 79.2<br>(19.6)            | 77.9<br>(19.3)                      |
| <b>BMI</b>                              | 27.4<br>(5.6)  | 27.0<br>(5.0)             | 27.4<br>(5.8)             | 27.7<br>(5.7)                       | 26.9<br>(5.2)             | 28.0<br>(5.5)             | 28.5<br>(6.6)                      | 27.6<br>(5.2)             | 27.6<br>(5.5)             | 26.9<br>(5.7)                       |
| <b>≤25 (underweight to normal)</b>      | 232<br>(36.1)  | 60<br>(35.1)              | 103<br>(38.6)             | 68<br>(33.7)                        | 166<br>(38.3)             | 35<br>(29.7)              | 25<br>(31.3)                       | 39<br>(33.1)              | 93<br>(34.6)              | 99<br>(39.1)                        |
| <b>&gt;25 and ≤30 (overweight)</b>      | 259<br>(40.3)  | 76<br>(44.4)              | 100<br>(37.5)             | 81<br>(40.1)                        | 178<br>(41.1)             | 47<br>(39.8)              | 31<br>(38.8)                       | 51<br>(43.2)              | 108<br>(40.1)             | 99<br>(39.1)                        |
| <b>&gt;30 (obese)</b>                   | 152<br>(23.6)  | 35<br>(20.5)              | 64<br>(24.0)              | 53<br>(26.2)                        | 89<br>(20.6)              | 36<br>(30.5)              | 24<br>(30.0)                       | 28<br>(23.7)              | 68<br>(25.3)              | 55<br>(21.7)                        |
| <b>Years since diagnosis, mean (SD)</b> | 5.8<br>(8.4)   | 5.8<br>(7.2)              | 6.4<br>(9.1)              | 4.8*<br>(7.7)                       | 5.9<br>(8.6)              | 5.4<br>(7.4)              | 5.4<br>(7.1)                       | 6.1<br>(7.7)              | 6.5<br>(9.4)              | 5.0*<br>(7.6)                       |
| <b>BSA, mean %, (SD)</b>                | 9.8<br>(11.3)  | 5.5<br>(7.9)              | 8.2*<br>(9.2)             | 15.2*<br>(13.8)                     | 8.0<br>(9.7)              | 12.3*<br>(13.7)           | 15.7*<br>(13.2)                    | 3.5<br>(6.7)              | 7.3*<br>(8.5)             | 15.2*<br>(13.1)                     |

SD: standard deviation; BMI: body mass index; BSA: body surface area. \* p<0.05 vs “none”

### Overall disease severity and comorbidities

Table 2 summarizes overall psoriasis disease severity and the prevalence of comorbidities by symptom severity. Overall, 47.8%, 45.8%, and 6.3% patients were considered by their physician to have mild, moderate, and severe psoriasis, respectively. Compared to patients who were not experiencing psoriasis-itching, significantly more patients with moderate-to-severe itching had moderate or severe psoriasis. A similar pattern was observed for psoriasis-related pain and scaling.

The most common comorbidities analyzed were hypertension (17.5%), anxiety (16.5%) and elevated cholesterol/hyperlipidemia (15.7%). Hypertension (32.2% vs. 14.4%), elevated cholesterol (28.9% vs. 13.7%) and diabetes (22.2% vs. 7.1%) were significantly more common among patients experiencing moderate-to-severe pain than patients without pain (all p<0.05), whereas anxiety (26.2% vs. 13.7%), depression (21.5% vs. 10.7%), and obesity (14.6% vs. 7.1%) were more prevalent among patients with mild pain compared to patients without pain (all p<0.05). Compared to patients with no itching (2.7%), obesity was more common among patients with moderate-to-severe (10%) or mild (13.1%) itching (both p<0.05). The mean number of comorbid conditions

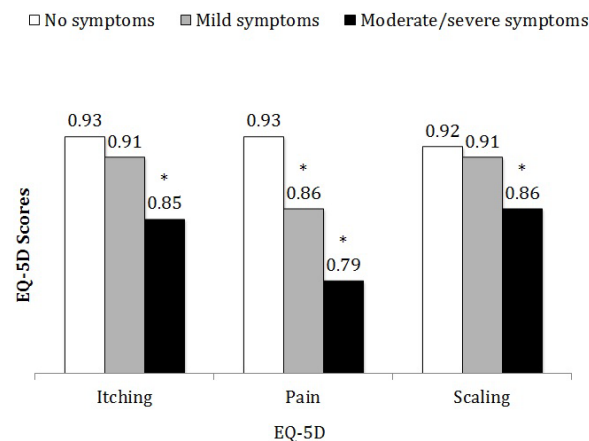
was 1.0, and this was significantly higher among patients experiencing moderate-to-severe pain (1.5) or mild pain (1.3) than patients with no pain (0.8) (both  $p < 0.05$ ).

**Table 2: Psoriasis overall disease severity and comorbidities by levels of severity for psoriasis related itching, pain and scaling**

|  | Total            | Itching          |                  |                  | Pain             |                   |                   | Scaling          |                  |                  |
|--|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|------------------|------------------|------------------|
|  |                  | None             | Mild             | Mod/severe       | None             | Mild              | Mod/severe        | None             | Mild             | Mod/severe       |
| <b>Overall current psoriasis severity (%)</b>  |                  |                  |                  |                  |                  |                   |                   |                  |                  |                  |
| Mild   | 47.8             | 70.1             | 64.1             | 9.3*             | 55.1             | 48.4              | 8.0*              | 80.5             | 71.0             | 8.6*             |
| Moderate                                       | 45.8             | 26.6             | 33.8             | 76.5             | 40.7             | 45.3              | 73.9              | 15.4             | 27.9             | 78.4             |
| Severe   | 6.3              | 3.3              | 2.1              | 14.2             | 4.3              | 6.3               | 18.2              | 4.1              | 1.0              | 12.9             |
| <b>Comorbidities (%)</b>                       |                  |                  |                  |                  |                  |                   |                   |                  |                  |                  |
| Hypertension                                   | 17.5             | 18.5             | 14.8             | 19.7             | 14.4             | 16.2              | 32.2*             | 21.3             | 12.7             | 20.5             |
| Anxiety  | 16.5             | 12.5             | 16.3             | 20.1             | 13.7             | 26.2*             | 17.8              | 17.2             | 16.2             | 16.6             |
| Depression                                     | 13.0             | 12.5             | 16.3             | 20.1             | 10.7             | 21.5*             | 11.1              | 14.8             | 14.8             | 10.6             |
| Elevated cholesterol                           | 15.7             | 14.1             | 15.2             | 17.9             | 13.7             | 12.3              | 28.9*             | 18.0             | 12.4             | 18.0             |
| Obesity  | 9.3              | 2.7              | 13.1*            | 10.0*            | 7.1              | 14.6*             | 12.2              | 9.0              | 8.6              | 10.2             |
| Diabetes                                       | 9.3              | 9.2              | 7.8              | 11.4             | 7.1              | 7.7               | 22.2*             | 9.0              | 6.9              | 11.7             |
| <b>Total number of comorbidities mean (SD)</b> | <b>1.0 (1.4)</b> | <b>0.8 (1.1)</b> | <b>1.1 (1.6)</b> | <b>1.1 (1.5)</b> | <b>0.8 (1.2)</b> | <b>1.3* (2.0)</b> | <b>1.5* (1.6)</b> | <b>1.2 (2.0)</b> | <b>0.8 (1.1)</b> | <b>1.1 (1.4)</b> |

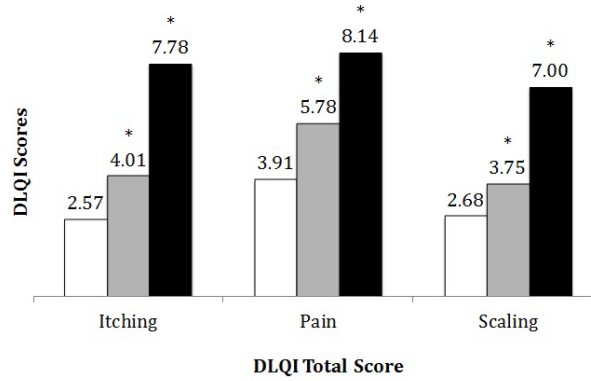
\* $p < 0.05$  vs. "none".

### Health Related Quality of Life

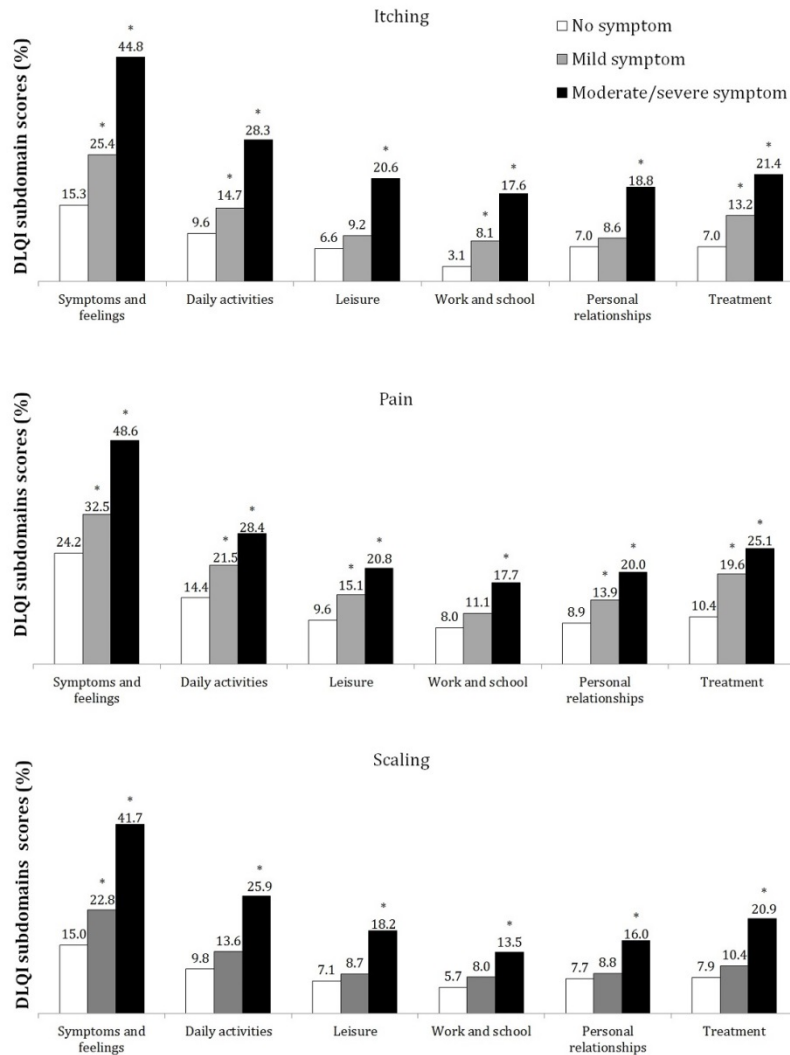


**Figure 1.** EQ-5D scores by psoriasis-related symptom severity \* $p < 0.05$  (significance relative to “none” for each of the symptoms, univariate analysis). Scores range from -0.59 to 1 and lower scores indicate reduced QoL.

Fig. 1 shows EQ-5D and DLQI scores by symptom severity levels. EQ-5D scores decreased from 0.93 for patients with no itching to 0.91 for those with mild itching down to 0.85 for those with moderate-to-severe itching ( $p < 0.05$  for moderate-to-severe compared to no itching). EQ-5D scores decreased from 0.93 for patients with no psoriasis-related pain to 0.86 for those with mild pain down to 0.79 for those with moderate-to-severe pain (both  $p < 0.05$  relative to no pain). EQ-5D scores decreased from 0.92 for patients with no scaling to 0.91 for those with mild scaling down to 0.86 for those with moderate-to-severe scaling ( $p < 0.05$  for moderate-to-severe compared to no scaling).

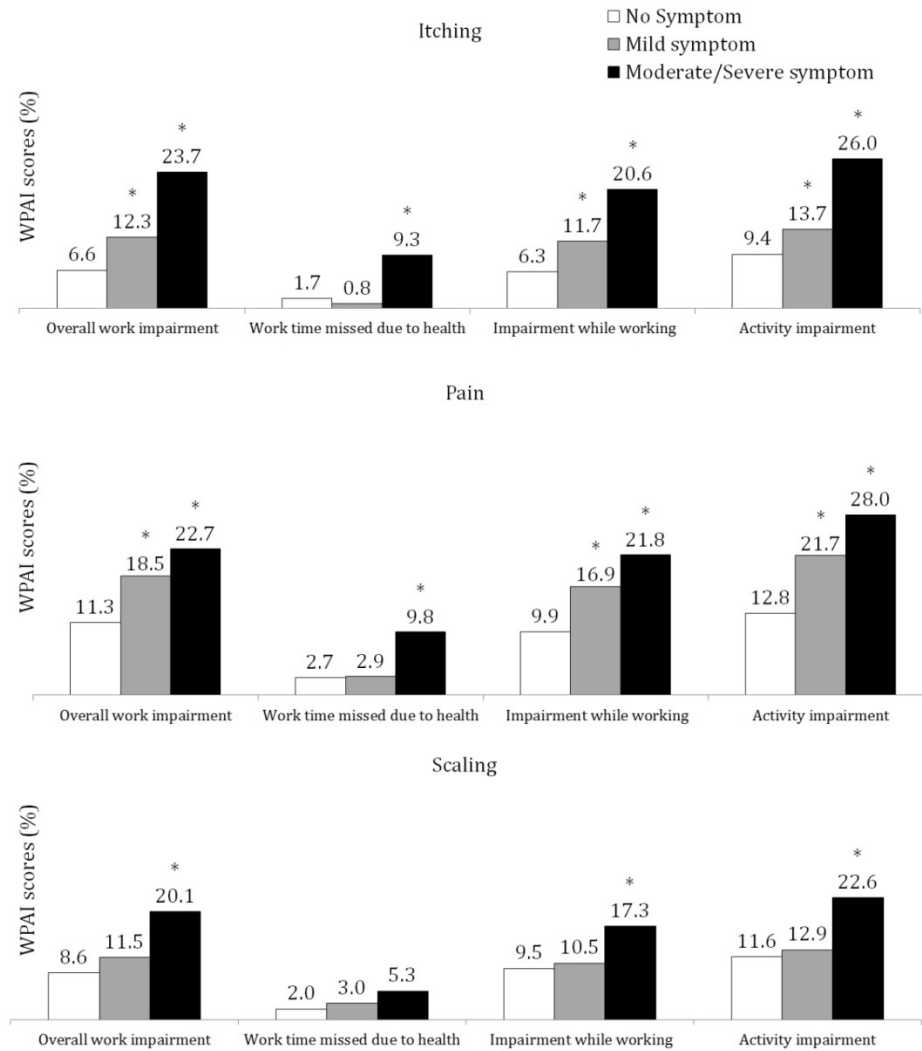


**Figure 2.** DLQI total scores by psoriasis-related symptom severity. \* $p < 0.05$  (significance relative to “none” for each of the symptoms, univariate analysis). DLQI scores range from 0-30. Higher scores indicate lower QoL.



**Figure 3.** DLQI subdomain scores by psoriasis-related symptom severity. \* $p < 0.05$  (significance relative to “none” for each of the symptoms, univariate analysis). DLQI scores range from 0-100%. Higher scores indicate lower QoL.

Figs 2-3 show that DLQI scores increased from 2.57 for patients with no psoriasis-related itching to 4.01 for those with mild itching up to 7.78 for patients with moderate-to-severe itching (both  $p < 0.05$  vs. no itching). The same pattern was revealed for the pain and scaling groups. Patients with mild as well as moderate-to-severe pain and scaling had higher DLQI scores than patients with no pain and no scaling, respectively (both  $p < 0.05$ ). Analyses were also conducted on the six DLQI subdomains (symptoms and feelings, daily activities, leisure, work and school, personal relationships, and treatment, see Fig 3). There were significant differences between patients with moderate-to-severe itching, pain, and scaling and patients with no itching, pain, and scaling, respectively, for all DLQI subdomains ( $p < 0.05$ ). In addition, some significant differences were observed between patients with mild symptoms relative to those with no symptoms across a subset of the DLQI subdomains.



**Figure 2.** Work productivity scores by psoriasis-related symptom severity. \* $p < 0.05$  (significance relative to “none” for each of the symptoms, univariate analysis). Scores range from 0-100%, higher scores indicate greater impairment/ less productivity. With the exception of activity impairment, domains are relevant only for employed patients.

Fig. 4 shows the work productivity (WPAI) data by symptom severity. Work productivity loss for employed patients ( $n = 461$ ) increased with the severity of itching from scores of 6.6 for patients with no itching to 12.3 for patients with mild itching up to 23.7 for moderate-to-severe itching ( $p < 0.05$  for both vs. no itching). Work productivity scores increased similarly with the severity of pain and scaling symptoms. The same pattern was true for the “impairment while working” and “activity impairment” subdomains across all three symptoms. In contrast, for the “work time missed” domain, scores were highest for patients with moderate-to-severe symptoms, but there were no significant differences between the symptom severity groups.



Table 3: Multivariate regression results: impact of symptom severity on psoriasis overall disease severity

|                                      | Overall disease severity |                         |
|--------------------------------------|--------------------------|-------------------------|
|                                      | Odds ratio               | 95% confidence interval |
| Mild itching <sup>1</sup>            | 1.3                      | (0.7, 2.3)              |
| Moderate/severe itching <sup>1</sup> | 15.9*                    | (7.7, 32.7)             |
| Mild pain <sup>2</sup>               | 1.2                      | (0.7, 2.0)              |
| Moderate/severe pain <sup>2</sup>    | 7.4*                     | (4.0, 13.6)             |
| Mild scaling <sup>3</sup>            | 1.5                      | (0.8, 2.6)              |
| Moderate/severe scaling <sup>3</sup> | 33.4*                    | (15.2, 73.1)            |

Three separate logistic regressions were performed to examine the impact on overall disease severity: <sup>1</sup> severity of itching (reference: no itching), <sup>2</sup> severity of pain (reference: no pain) and <sup>3</sup> severity of scaling (reference: no scaling). Regressions controlled for demographics (age, gender, ethnicity) and comorbidities (possible psoriatic arthritis, hypertension, elevated cholesterol, depression, obesity and diabetes). \*p<0.05.

### Multivariate analysis

Results of the multivariate analyses for the impact of symptom severity on overall disease severity, HR-QoL and work productivity are summarized in Tables 3 and 4, respectively. Separate regressions were conducted for itching, pain, and scaling symptoms while controlling for between group differences in demographics and comorbidities. Patients with moderate-to-severe itching, pain, and scaling (but not mild symptoms) were more likely to have more severe overall psoriasis compared to patients with no itching, no pain, or no scaling (odds ratio [OR] = 15.9, 7.4 and 33.4, respectively). Analysis of QoL (measured via EQ-5D as well as the total DLQI and all 6 of its subdomains) and WPAI scores revealed that patients with moderate-to-severe symptoms had worse outcomes across all measures compared to patients without these symptoms, with the exception of the work time missed subdomain of the WPAI. Regression analyses also revealed reduced HR-QoL and work productivity for patients with mild itching vs. no itching and mild pain vs. no pain.

Table 4: Multivariate regression results: impact of psoriasis symptom severity on quality of life and work productivity.

|                         | QoL                      |                    |                                       |                                  |                                |                                 |  |                           |
|-------------------------|--------------------------|--------------------|---------------------------------------|----------------------------------|--------------------------------|---------------------------------|--|---------------------------|
|                         | EQ-5D                    | DLQI total         | DLQI subdomain: Symptoms and feelings | DLQI subdomain: Daily activities | DLQI subdomain: Leisure domain | DLQI subdomain: Work and school | DLQI subdomain: Personal relationships | DLQI subdomain: Treatment |
| Mild itching            | -0.02<br>(-0.03,0.00)    | 1.5*<br>(0.8,2.3)  | 10.1*<br>(5.9,14.3)                   | 5.2*<br>(1.8,8.5)                | 3.1*<br>(0.5,5.8)              | 5.9*<br>(2.6,9.3)               | 2.0<br>(-1.2,5.2)                      | 6.0*<br>(2.4,9.6)         |
| Moderate/severe itching | -0.07*<br>(-0.09,-0.04)  | 4.9*<br>(3.9,5.9)  | 27.7*<br>(22.8,32.7)                  | 17.5*<br>(12.9,22.1)             | 13.5*<br>(9.6,17.4)            | 14.3*<br>(9.6,19.1)             | 10.8*<br>(6.9,14.6)                    | 12.6*<br>(8.2,16.9)       |
| Mild pain               | -0.04*<br>(-0.07,-0.02)  | 1.5*<br>(0.4,2.6)  | 6.5* (1.3,11.7)                       | 5.7*<br>(1.1,10.2)               | 4.9*<br>(0.7,9.2)              | 2.7<br>(-2.7,8.1)               | 4.7*<br>(0.2,9.1)                      | 6.9* (1.3,12.6)           |
| Moderate/severe pain    | -0.11*<br>(-0.15,-0.07)  | 3.8*<br>(2.4,5.3)  | 22.9*<br>(17.1,28.7)                  | 11.0*<br>(4.4,17.6)              | 10.5*<br>(4.7,16.3)            | 9.7* (2.2,17.2)                 | 10.3*<br>(3.5,17.0)                    | 11.6*<br>(5.2,18.0)       |
| Mild scaling            | -0.00<br>(-0.03,0.02)    | 0.9<br>(0.0,1.8)   | 7.2* (2.9,11.5)                       | 2.8<br>(-0.9,6.4)                | 1.3<br>(-1.8,4.5)              | 2.9<br>(-1.7,7.5)               | 0.1<br>(-3.7,4.0)                      | 2.0<br>(-2.0,6.0)         |
| Moderate/severe scaling | -0.05*<br>(-0.08,-0.02)  | 3.8*<br>(2.7,5.0)  | 25.0*<br>(19.7,30.2)                  | 13.6*<br>(8.7,18.6)              | 10.0*<br>(6.1,13.7)            | 8.0* (2.6,13.4)                 | 7.0* (2.5,11.5)                        | 11.1*<br>(6.4,15.7)       |
| Work Productivity       |                          |                    |                                       |                                  |                                |                                 |  |                           |
|                         | % Work productivity loss | % Work time missed | % Impairment at work                  | % Activity impairment            |                                |                                 |  |                           |
| Mild itching            | 6.0* (1.8,10.1)          | -0.8<br>(-3.4,1.9) | 5.7*<br>(2.1,9.4)                     | 4.7*<br>(1.6,7.7)                |                                |                                 |  |                           |
| Moderate/severe itching | 17.6*<br>(11.8,23.5)     | 5.8*<br>(0.5,11.1) | 14.7*<br>(10.0,19.4)                  | 15.6*<br>(11.5,19.7)             |                                |                                 |  |                           |
| Mild pain               | 5.0<br>(-0.4,10.5)       | -0.5<br>(-3.6,2.6) | 6.4*<br>(1.5,11.3)                    | 8.1* (3.4,12.7)                  |                                |                                 |  |                           |
| Moderate/severe pain    | 11.5*<br>(2.6,20.4)      | 5.3<br>(-2.7,13.3) | 11.9*<br>(4.4,19.3)                   | 12.3*<br>(4.8,19.8)              |                                |                                 |  |                           |
| Mild scaling            | 4.1<br>(-1.3,9.6)        | 0.3<br>(-3.6,4.1)  | 2.4<br>(-2.7,7.4)                     | 1.7<br>(-2.7,6.1)                |                                |                                 |  |                           |
| Moderate/severe scaling | 12.0*<br>(5.6,18.5)      | 2.9<br>(-1.8,7.5)  | 8.2*<br>(2.4,14.0)                    | 10.4*<br>(5.0,15.8)              |                                |                                 |  |                           |

Linear regression coefficients (95% confidence interval). For each outcome measure, three separate linear regression were performed. The impact on QoL/work productivity was examined for severity of itching (reference: no itching), severity of pain (reference: no pain) and severity of scaling (reference: no scaling). All analyses controlled for age, gender, ethnicity, body mass index category, psoriatic arthritis, hypertension, elevated cholesterol, anxiety, depression, and diabetes. \* $p < 0.05$

## Discussion

Using recent data collected from psoriasis patients and their dermatologists in the US, this study explored the impact of psoriasis-related itching, pain, and scaling on overall disease severity, HR-QoL, and work productivity. Not only did many patients experience itching and scaling, they commonly experienced moderate-to-severe levels of these symptoms. Even after controlling for differences in demographics and comorbidities, we found that psoriasis patients with increased severity of itching, pain, and scaling were more likely to have increased overall disease severity, reduced HR-QoL, and reduced work productivity.

The observed frequency of itching and scaling was over 70% in the present study and a moderate-to-severe level of the symptom was reported for approximately one-third of patients. The high prevalence of itching and scaling has been previously reported [7, 11]. However, less is known about how severity levels of these symptoms vary. Although psoriasis-related skin pain was notably less common, it was still experienced by nearly one-third of patients, with 13.1% reported as experiencing pain at a moderate-to-severe level by their dermatologist. Not surprisingly, patients with moderate-to-severe psoriasis-related itching, pain, and scaling often also had moderate or severe overall psoriasis. However, patients with mild, or even no itching, pain, and scaling were sometimes also reported as having moderate or severe overall psoriasis. Clearly, there is an association between overall disease severity and symptom severity; however, the two are not perfectly correlated. We posit that it is important for both physicians and patients to understand that the overall disease severity, as well as the severity of key symptoms, need to be assessed in order to get a complete picture of this disease.

Only a few studies have examined the relationship between psoriasis symptoms and HR-QoL to date, and most have focused on a single symptom, usually itching [4, 10, 18, 19]. Similar to the findings in previous studies, this analysis demonstrated that itching had a negative impact on HR-QoL and that the impact increases with the severity of itching [4, 18, 26]. Also confirming findings from previous studies, [4, 26] the impact on HR-QoL increased as the severity of itching increased.

Although the least common of the three symptoms, psoriasis-related pain was associated with some of the poorest outcomes as measured by DLQI and EQ-5D, pain also had a stronger association with comorbid conditions than either scaling or itching. However, this alone may not explain the impact of pain on HR-QoL outcomes given that regression analyses controlled for this. Interestingly, whereas mild skin pain was associated with anxiety, depression, and obesity, moderate-to-severe pain was associated with a distinct set of comorbidities (hypertension, elevated cholesterol, and diabetes). We believe that there may be a distinction between comorbid conditions with a psychological component (association with mild pain) and those that are more purely physiological (association with moderate-to-severe pain) but further work will be needed to clarify this complex relationship. Also of note is that the rate of obesity in the present study (9%) is somewhat lower than obesity rates reported previously for psoriasis patients [27]. Differences may be due to how obesity is measured/reported (e.g. BMI vs. physician reported).

The effect of scaling on HR-QoL has received minimal attention in the literature but our results suggest that this may have been an oversight. Moderate-to-severe psoriasis-related scaling compared to no scaling had a significant impact on HR-QoL as measured by EQ-5D and all DLQI subdomains, although multiple regression data suggests that mild scaling (unlike mild pain or mild itching) was well tolerated. Psoriasis lesions on visible body parts are known to be particularly distressing for patients [28]. Potentially, when scaling is mild, it is easier for patients to conceal, thus minimizing the psychological impact.

An additional aspect of disease burden experienced by psoriasis patients is a negative impact on work productivity, which increases with more severe overall disease [16]. However, little is known about if the severity of specific psoriasis symptoms similarly affects productivity at work. In the present study, a more severe level of psoriasis-related itching, pain, and scaling were all associated with reduced overall work productivity, work impairment, and activity impairment. Moderate-to-severe itching may be a particular problem as this was associated with a greater percentage of work time missed.

Findings from this study suggest that the key clinical symptoms of psoriasis have an important impact on HR-QoL and work productivity. The impact is greatest when these symptoms are moderate-to-severe. However, even mild itching and pain are associated with negative outcomes on a range of measures. Clinicians should therefore be sensitive to the presence of specific symptoms and their severity when deciding on the most appropriate treatment strategy. Since pain and itching are typically not readily observable, inquiry by the physician regarding these symptoms will need to become a part of the physician-patient

dialogue. Our findings support the concept that psoriasis overall disease severity, whilst a critical clinical variable, may not tell the whole story.

There are limitations to our study. One important limitation is that the psoriasis patient sample was identified from patients who attended a consultation with their physician. Because patients currently experiencing problems with their psoriasis are more likely to consult, these patients may be over represented in our sample.

## Conclusions

Increased severity of itching, pain, and scaling was associated with increased overall psoriasis disease severity, reduced HR-QoL, and reduced work productivity. It is important that physicians recognize that any one of these three symptoms can have a significant impact on patients' lives.

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