

# Rasch analysis of the dermatology life quality index (DLQI) in patients with mild to moderate-severe psoriasis

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## Abstract

**Background:** The Dermatology Life Quality Index (DLQI) is a valuable tool for assessing the quality of life in adult patients with psoriasis.

**Aims:** To analyse the reliability and validity of the DLQI to measure the quality of life in patients with mild to moderate-severe psoriasis.

**Methods:** This was a secondary validation study nested in a follow-up study. The Rasch-Andrich model was utilised to perform response function, item and person fit, differential item functioning, dimensionality, and reliability analyses.

**Results:** A total of 1439 patients were analysed, 52.1% male, mean age of 48.7 years (SD 16.1). Psoriasis vulgaris was the phenotype in 43.1% of patients, and 86% had a mild Psoriasis Area Severity Index (PASI). Adequate adjustment of the response function and the items was observed in the best-fit sample, except for item 7 (work and study). The measure explained 60.9% of the variance and presented a reliability of 0.86. Differential item functioning was identified by age, with a relevant bias in the estimation for older adults. Item-person maps are provided.

**Limitations:** This study was performed at a single centre, with most patients presenting a mild PASI score, limiting generalisation of the findings.

**Conclusion:** The validity evidence favours the use of the DLQI in moderate-severe psoriasis. However, the instrument biases the estimate of older adults. This population group should consider a specific version of the instrument.

**Key words:** Psoriasis, Quality of life, Dermatology Life Quality Index, Validation study

## Plain Language Summary

Psoriasis is a chronic inflammatory disease that can impact the personal appearance, which may increase susceptibility to psychological disorders impacting the patient's quality of life. The Dermatology Life Quality Index (DLQI) is one of the primary methods for its good psychometric performance. Our study analysed its reliability and validity in 1329 Colombian adult patients with mild to moderate-severe psoriasis. In general terms, the psychometric findings favor the DLQI's validity for its use among these patients. However, we identified a significant bias when the DLQI is applied to older adults with psoriasis. We recommend developing a specific version of the DLQI for older adult patients to capture the relevant aspects of quality of life from their perspective, avoiding misclassification of the impact of the disease on their daily living.

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## Introduction

Psoriasis is a chronic inflammatory disease with significant social and healthcare implications. Its prevalence is unclear due to the heterogeneity of the clinical manifestations and diagnostic and classification criteria; however, it is estimated to affect between 2–3% of the global population. Although the clinical manifestations are variable, in most patients there is a great effect on their quality of life. Psoriasis can be associated with a significant economic burden associated with medical care, occupational costs, and social dependency, which can be compared with the financial burden caused by other diseases such as cancer, melanoma, and asthma.<sup>1,2</sup>

As with other dermatological diseases, psoriasis can impact personal appearance, generating greater susceptibility to developing psychological disorders, sleep disorders, and depression that affect work and daily activities.<sup>3</sup> In this sense, the health-related quality of life (HRQOL) concept becomes more relevant, considering the disease's impact on the patient's social relationships, psychological status, and daily functioning.

The Dermatology Life Quality Index (DLQI) is one of the primary methods for measuring health-related quality of life in patients with dermatologic diseases. This instrument has been analysed in various systematic reviews, highlighting its ease of use due to its brevity and simplicity, with an average response time of 2 minutes. It can be used in approximately 30 dermatologic diseases with empirical support for its external validity. Additionally, it has been established that the DLQI is sensitive to the quality-of-life changes at different stages of the disease.<sup>4,5</sup>

Despite its strengths, several studies have reported significant differences in its performance, depending on patient demographic and clinical characteristics. Age, sex, and disease severity are characteristics that condition psychometric performance. Thus, verifying DLQI psychometric performance in local studies is essential to ensure its suitability to support decision-making.<sup>6,7</sup> In Colombia, no specific studies have evaluated the psychometrics of DLQI, by focusing on its potential bias among clinical and demographic-relevant subgroups.

This study uses the Rasch model to analyse the reliability and validity of DLQI to measure the quality of life in patients diagnosed with mild to moderate-severe psoriasis at the Comprehensive Clinic for Immune-Mediated Skin - CLIPSO (Medellin, Colombia).

## Materials and Methods

### Design

Validation study secondary to the follow-up of a cohort of patients with moderate-severe psoriasis who had attended the Comprehensive Clinic for Immune-Mediated Skin - CLIPSO in Medellín-Antioquia. The CES University Institutional Human Research Ethics Committee approved the original study.

### Instrument

The DLQI is a self-administered instrument to assess the quality of life of dermatology patients with ten questions covering the last seven days. They measure the dimensions of health like: symptoms and perceptions, daily activities, recreation, work/study, interpersonal relationships, sexuality, and treatment. Each question has a Likert-type scale with four answer options: 0: not at all, 1: a little, 2: a lot, 3: very much. The final score is obtained by summing the score of each item and ranges from 0 (minimum impact on quality of life) to 30 points (maximum impact on quality of life).<sup>3,8</sup>

### Participants

The study included 1439 patients diagnosed with moderate-severe psoriasis who attended Comprehensive Clinic for Immune-Mediated Skin between January 2018 and December 2019. The integral healthcare programme in the institute comprises an interdisciplinary group of health professionals: general physician, dermatologist, pharmacist, nurse, nutritionist, physical therapist, and rheumatologist. The DLQI questionnaire was administered at programme admission and each follow-up consultation. The frequency of follow-up could be monthly, quarterly, half-yearly, or yearly, depending on the clinical condition of the patient and the treatment used. The most recent application of DLQI was analysed for this validation study.

### Statistical analysis

Considering the ordinal nature of the response options of DLQI, the Rasch-Andrich rating scale model for polytomous items was used. Psychometric analyses were performed in the entire sample and the best-fit sample. Optimal fit for persons was defined as infit and outfit statistics in the range of 0.5 to 1.5. Statistical analyses were performed in Winsteps 4.5.5.

### Category function

To understand how the patients use the ordinal responses of the DLQI, compliance with Linacre's category function optimisation criteria was assessed.<sup>9</sup> For this purpose, the distribution of answers, average measures, outfit mean squares, rich limits, and coherences are analysed.

### Item and person fit statistics

To evaluate if the response patterns of patients to the items of the DLQI adjust to the Rasch model assumptions, the following statistics were estimated: infit and outfit mean squares with expected value in the range 0.5–1.5, discrimination index with expected value >0.3, and the measure location (in logits) with standard error for each item.

### Differential Item Functioning (DIF)

As the psychometric performance of the DLQI may be different in clinical and sociodemographic subgroups, potential biases in the estimation of quality of life were explored with differential item functioning analysis. Potential biases in measure estimation were analysed by sex (female, male), age groups (young adult: <40 years, middle adult: <65

years, older adult:  $\geq 65$  years), and severity of psoriatic lesions (mild, moderate, severe). The differential item functioning contrasts, defined as the differences in the quantity of quality of life that each item measures, joint standard errors, and p-values were estimated using the Rasch welch test; p-values  $< 0.05$  were considered statistically significant. Items were classified as B-type DIF (mild-moderate) if the absolute value of the contrast  $\geq 0.43$  and as C-type DIF (moderate-severe) if the absolute value of the contrast  $\geq 0.64$ . Items with a lower value or no statistical significance were classified as A-type DIF (insignificant).<sup>10</sup> Bland-Altman agreement plots were constructed to compare the original measure with the unbiased measure obtained with the DIF-free items to assess the impact of DIF on the DLQI total estimation.

**Dimensionality, reliability, and item-person maps**

Structural validity was analysed with the criteria of one-dimensionality: 1) variance explained by the measure  $> 40\%$ , 2) eigenvalue of the first residual test  $< 2.0$ , 3) disattenuated correlation between clusters 1 and 3 of the first residual test  $> 0.70$ , and 4) conceptual irrelevance of the separation of the items in these two clusters. In addition, the local independence between items was assessed by the Q3 statistic with an expected value  $< 0.5$ . Finally, the items map is presented by plotting each response to each item on the Rasch scale based on its Rasch–Thurstone threshold, which corresponds to the logit value for the cumulative probability of 50%.<sup>11</sup> Rasch reliability index for persons was estimated.

**Results**

**Characteristics of the participants**

Demographic and clinical characteristics of the entire sample and the best-fit sample are presented in Table 1. In the best-fit sample, 50.2% were male, 41.1% were middle-aged adults, and 85.3% had mild psoriatic lesions. The most common phenotype was psoriasis vulgaris (41.6%), followed by scalp psoriasis (13.7%). The best-fit sample consists of 810 participants.

**Category function**

In the category function analysis [Table 2], with four categories, the most frequent answer was 0: “not at all” in the total and best-fit samples, with 54% and 56%, respectively. In addition, category 4: “very much” was the least used with 11%. There is an increase in the average measure in correspondence with ordinality. Mean squares of outfit and infit were within 0.5 to 1.5. and Rich’s thresholds increase on average by one logit between categories. Category 3 showed a low coherence of 36%, slightly below the expected 40%. Acceptable compliance with Linacre’s criteria was achieved in the best-fit sample.

**Item and person fit statistics**

Concerning the fit of persons, 87% showed adequate in-fit, and 84.7% showed an adequate outfit. In the item fit analysis [Table 3], an initial analysis was made with the total sample, indicating that item 7 did not meet the infit and outfit criteria

**Table 1: Characteristics of the participants**

Variable	Full sample (n = 1439)		Best-fit sample (n = 810)	
	n	%	n	%
<b>Sex</b>				
Female	750	52.1	407	50.2
Male	689	47.9	403	49.8
<b>Age group</b>				
Teenager	92	6.4	60	7.4
Young adult	474	32.9	284	35.1
Middle adult	626	43.5	333	41.1
Older adult	247	17.2	133	16.4
<b>Psoriasis severity (PASI)</b>				
Mild	1.238	86.0	691	85.3
Moderate	139	9.7	86	10.6
Severe	62	4.3	33	4.1
<b>Phenotypes</b>				
Vulgaris	620	43.1	337	41.6
Scalp	210	14.6	111	13.7
Inverse	28	1.9	16	2.0
Nail	148	10.3	83	10.2
Guttata	23	1.6	18	2.2
Erythrodermic	3	0.2	0	0.0
Non-pustular palmoplantar	42	2.9	22	2.7
Pustulosis palmoplantar	20	1.4	11	1.4
Psoriatic arthritis	127	8.8	68	8.4
<b>Number of phenotypes</b>				
0	637	44.3	371	45.8
1	473	32.9	264	32.6
2	250	17.4	130	16.0
3	71	4.9	40	4.9
4	6	0.4	3	0.4
5	2	0.1	2	0.2

**Table 2: Category function of DLQI items**

Score	n	%	Average	Mean-squares		Andrich Threshold		Coherences	
				Infit	Outfit	e.e.	M->C	C->M	
<b>Total sample</b>									
0	7714	54	-2.4	1.0	1.0	-	-	84	75
1	3068	21	-0.9	0.9	0.8	-1.0	0.02	45	58
2	2012	14	0.2	1.0	1.3	0.0	0.03	42	50
3	1596	11	1.2	1.2	1.3	1.0	0.04	70	37
<b>Best-fit sample</b>									
0	4521	56	-2.4	0.9	0.9	-	-	82	69
1	1527	19	-0.9	1.0	0.9	-1.2	0.04	42	57
2	1208	15	0.2	1.1	1.1	-0.1	0.04	44	50
3	854	11	1.4	1.1	1.0	1.3	0.05	68	36

n: number of total responses; e.e.: standard error; M: measure; C: category; M->C: the measure involves the category (%); C->M: the category implies the measure (%).

**Table 3: Location and fit statistics of the DLQI items**

Ítem	Total sample					Best fit sample				
	Measure	e.e.	Infit	Outfit	Corr.	Measure	e.e.	Infit	Outfit	Corr.
1. Itching, discomfort, pain, or stinging sensation	-1.4	0.04	1.1	1.3	0.8	-1.6	0.06	1.1	1.1	0.8
2. Embarrassed, self-conscious	-1.0	0.04	0.8	0.9	0.8	-1.1	0.06	0.8	0.8	0.8
3. Shopping, taking care of the house or garden	0.2	0.04	0.9	0.8	0.7	0.1	0.06	1.0	1.0	0.8
4. Clothing	-0.5	0.04	1.0	1.0	0.8	-0.8	0.06	1.1	1.1	0.8
5. Social and recreational activities	-0.7	0.04	0.7	0.6	0.8	-0.8	0.06	0.7	0.7	0.8
6. Sports	0.0	0.04	1.0	0.9	0.7	-0.2	0.06	1.0	0.9	0.8
7. Work and study	1.8	0.06	2.2	2.1	0.5	2.8	0.11	2.0	1.0	0.5
8. Partner, friends, family	0.2	0.04	0.9	0.8	0.7	0.2	0.06	1.0	1.0	0.7
9. Sexual difficulties	0.6	0.05	1.1	0.9	0.7	0.6	0.07	1.0	0.9	0.7
10. Treatment	0.9	0.05	1.3	1.3	0.6	0.8	0.07	1.1	1.1	0.7

e.e.: standard error; Corr.: Item-total correlations. Infit and outfit measures are expressed as mean-squares.

**Table 4: Differential Item Functioning (DIF) according to sex, age, and psoriasis severity**

Ítem	Sex		Age			Psoriasis severity		
	Female	Male	Young adult	Middle adult	Older adult	Mild	Moderate	Severe
1. Itching, discomfort, pain, or stinging sensation	-0.3*	0.3	0.2	0.1	-0.6 <sup>B</sup>	0.0	-0.1	0.2
2. Embarrassed, self-conscious	-0.1	0.1	-0.2*	0.1	0.0	0.0	-0.3	0.4
3. Shopping, taking care of the house or garden	-0.2	0.1	0.3*	-0.2	-0.2	-0.1	0.1	0.6 <sup>B</sup>
4. Clothing	-0.6 <sup>B</sup>	-0.3	-0.2*	0.1	0.4*	0.0	-0.1	-0.4
5. Social and recreational activities	0.2	-0.1	-0.1	0.1	0.0	0.1	-0.3	0.0
6. Sports	0.3*	-0.1	0.2	-0.1	-0.1	0.0	0.1	-0.2
7. Work and study	-0.1	-0.1	0.3	-0.4*	1.4 <sup>C</sup>	0.1	0.1	-0.7 <sup>C</sup>
8. Partner, friends, family	0.2	0.3	-0.1	0.1	0.0	-0.0	0.2	0.1
9. Sexual difficulties	0.3*	0.4	-0.2*	0.1	0.6 <sup>B</sup>	-0.0	0.2	-0.2
10. Treatment	0.4*	-0.5	0.2	-0.1	0.0	0.0	0.0	-0.1

B: mild to moderate (DIF ≥0,43 y p-value <0,05); C: DIF moderate to severe (DIF ≥0,64 y p-value <0,05); \*: p-value < 0,05.

with values of 2.2 and 2.1, respectively. The rest of the items met the infit criteria, between 0.7 for “social and recreational activities” to 1.3 for “treatment”, and the outfit criteria, between 0.6 for “social and recreational activities” to 1.3 for “treatment”. The item-measure correlations ranged from 0.5 for “work and study” to 0.8 for “social and recreational activities”. The analysis performed on the best-fit sample, in which the atypical respondents to item 7 were eliminated, presents an adequate outfit statistic but does not meet the infit criterion (>0.5). Therefore, the poor fit of item 7 is mainly explained by atypicality, which was evaluated by DIF analyses.

**Differential item functioning (DIF)**

Table 4 shows the differential item functioning analysis of the DLQI. Type B DIF was found in the item “clothing” for women (male reference). In the older adult age group, type C DIF was detected for the item “work and study”, and type C DIF was detected for items “itching, discomfort, pain or stabbing sensation” and “sexual difficulties”. Additionally, type B DIF was detected for severe PASI in “shopping, taking care of the house or garden”.

Figures 1a and 1b show the Bland and Altman limits of agreement for estimating the quality-of-life measure of the original scale vs. the bias-free scale, according to age and the PASI. For the group of older adults [Figure 1a], the DIF items caused a considerable bias in the estimation (bias = 0.12; 95% CI 0.11–0.12); this bias has a differential behaviour according to score level. Concerning the PASI [Figure 1b], the bias in the estimation was not relevant (bias = 0.01; 95% CI 0.00–0.02).

**Unidimensionality, reliability, and item mapping**

The measure obtained from the DLQI explained 60.9% of the total variance. No evidence of multidimensionality was found, with the eigenvalue of the first residual contrast = 1.7 (6.7%). The disattenuated correlation between clusters 1 and 3 of the first contrast was 0.70. There was no evidence of autocorrelation between residuals of items with correlations lower than 0.4 in all cases. Reliability was 0.86. Figure 2 shows the item-person map for the best-fit sample, and Figure 3 shows the item-person map for the older adults.

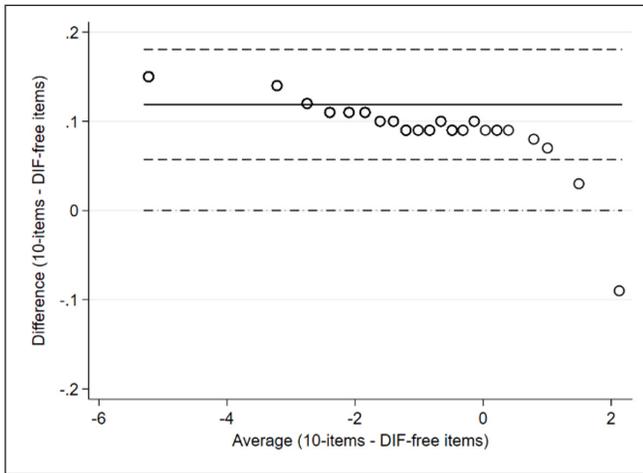


Figure 1a: Bias for older adults.

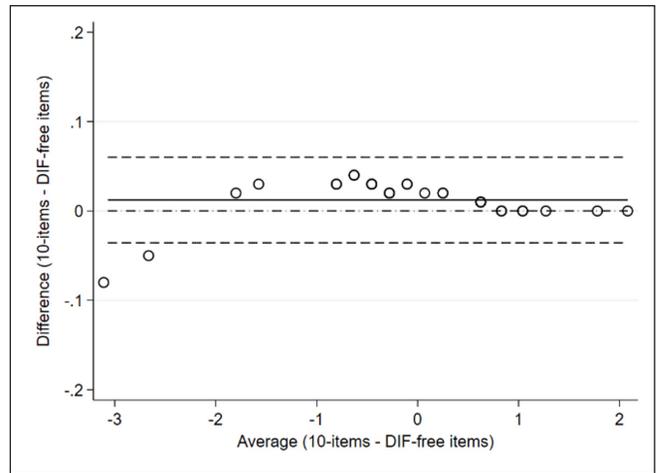


Figure 1b: Bias for severe psoriasis.

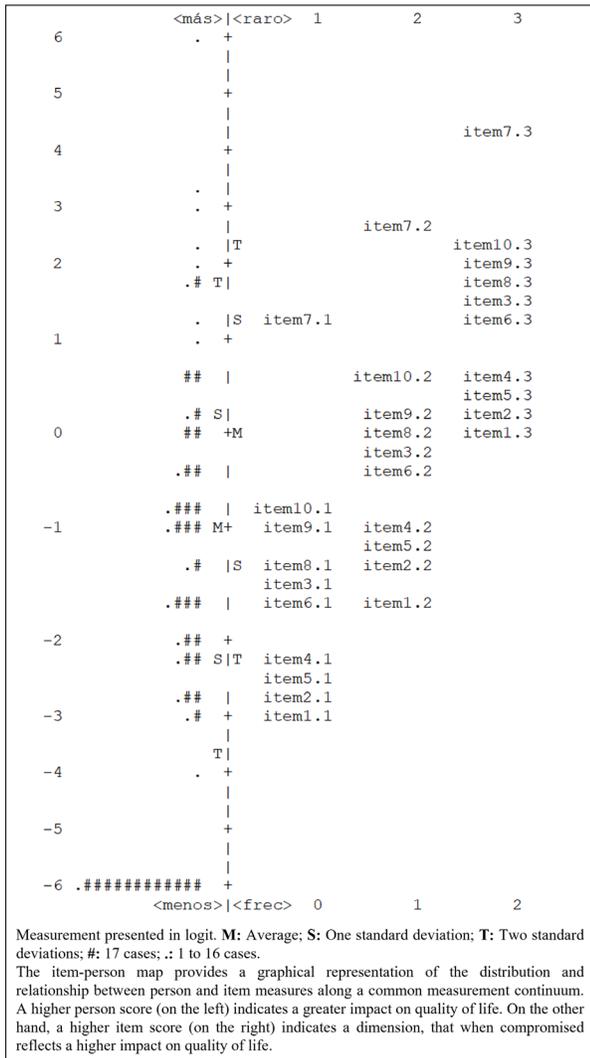


Figure 2: Item-person map for the best-fit sample of DLQI items in all the samples.

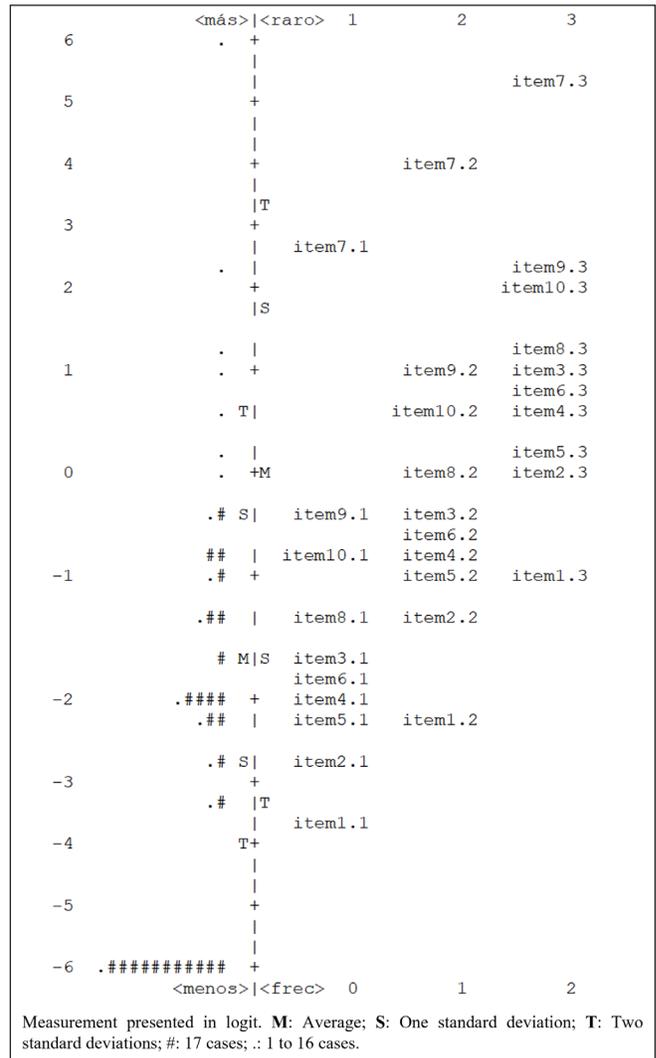


Figure 3: Item-person map of DLQI persons in older adults.

## Discussion

The results of this study add evidence to the validity of DLQI in Colombian people living with psoriasis, providing information on the classification and response profile that facilitates its interpretation and usefulness for clinical decision support.

According to the category function results, the patients evaluated can discriminate against their psoriasis-related quality of life impairment. However, it is necessary to consider that the instrument does not adequately capture potentially relevant differences among low scorers due to the floor effect. This implies that DLQI allows the identification of people with lower quality of life, but its performance in characterising less affected patients is inadequate. Consequently, improved characterisation of the HRQOL gains due to the patient's response to treatment would require including items that reflect daily life functionality better.

The question related to work and study presented some item fit difficulties, mainly among older adults and patients with a severe PASI classification. It should be noted that this item is the only one with different response options in the questionnaire, which could explain in some way the inconsistencies found. Authors such as Mørk *et al.*<sup>12</sup> in their validation study of DLQI in the Norwegian population, agree with this hypothesis and suggest that a possible solution is to change the response options to ones like the other items.

In this study, DIF was identified in three of the ten items for the older adults subgroup (sexual difficulties, work and study, and skin discomfort), which, according to Bland and Altman's agreement, induced a relevant bias in the overall DLQI estimation. It is essential to consider that the meaning of quality of life in older adults may have a different perspective. In this sense, for Vera *et al.*,<sup>13</sup> the meaning of quality of life for this population focuses mainly on tranquillity, care, protection, affection, and respect, helping them to achieve their goals and allowing them to express themselves freely and make decisions.

Cosco *et al.*<sup>14</sup> state that the challenges of the young population differ from those of the adult population, so they consider it relevant to adapt or create scales to measure resilience in this population. A study by the National Autonomous University of Mexico on the Rosenberg Scale in the older adult population indicates that self-esteem may be affected by variables such as social, physical, and psychological changes at this stage, which may explain the inconsistencies found in the items on sexual relations and work and study.<sup>15</sup> Another factor to consider is that social isolation increases as we age, and cognitive and physical functions deteriorate, as a Brazilian study on life purpose in older adults shows. This may explain the results in the work and study item.<sup>16</sup>

Our results from the Rasch analysis are similar to those previously reported in other populations. Twiss *et al.*<sup>17</sup> found age, gender, and severity-related differential item functioning in patients from the United Kingdom diagnosed with

psoriasis or atopic dermatitis. However, unlike our findings in Colombian patients, they identified more pronounced issues in items 2 (“embarrassed, self-conscious”) and 10 (“treatment”). Poor fit has also been found in patients diagnosed with other specific dermatological conditions such as hand eczema,<sup>18</sup> neurodermatitis,<sup>19</sup> and in patients with various skin diseases,<sup>20</sup> leading to recommendations for modifications to the DLQI.

Regarding the specific issues with item 7 (“work and study”), Rencz *et al.*<sup>21</sup> also identified this limitation in Hungarian patients with psoriasis and concluded that treating missing responses as a score of 0 is the best alternative to reduce misfit and DIF. It is important to note that item 7 is the only item in the DLQI with a conditional response.”

This study has some limitations. It was performed at a single centre, with most patients presenting a mild PASI score, thus limiting generalisation of the findings. However, our findings mainly refer to the scale psychometric performance and are concordant with previous Rasch analyses, as described before. It is also relevant to highlight that even though the sample size was not estimated a priori for the psychometric analyses, this did not represent a limitation related to statistical power and DIF contrasts were statistically significant. Lastly, the findings related to measuring the quality of life in older adults with psoriasis must be confirmed in additional studies that design and validate adaptations of DLQI to capture relevant effects on their daily living activities.

## Conclusion

The validity evidence favours the use of DLQI in moderate-severe psoriasis. However, the instrument has biases in its estimates for older adults. Therefore, for this population group a modified version of the instrument may be considered.

### Ethical approval

The study was approved by the scientific area of the health Institution and the insurer. This research was considered safe according to Resolution 8430 of 1993, under the Colombian regulations for research with human subjects.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

### Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

## References

- Feldman SR, Burudpakdee C, Gala S, Nanavaty M, Mallya UG. The economic burden of psoriasis: A systematic literature review. *Expert Rev Pharmacoecon Outcomes Res.* 2014;14:685–705.
- Burgos-Pol R, Martínez-Sesmero JM, Ventura-Cerdá JM, Elías I, Caloto MT, Casado M. Coste de la psoriasis y artritis psoriásica en cinco países de Europa: una revisión sistemática. *Actas Dermosifiliogr.* 2016;107:577–90.
- Restrepo C, Escobar Valencia C, María A, Giraldo M, Arango ST, Iván H, *et al.* Instrumentos de evaluación de la calidad de vida en dermatología. *Iatreia.* 2013;26:467–75.
- Bronsard V, Paul C, Prey S, Puzenat E, Gourraud P-A, Aractingi S, *et al.* What are the best outcome measures for assessing quality of life in plaque type psoriasis? A systematic review of the literature. *J Eur Acad Dermatol Venereol.* 2010;24:17–22.
- Poór AK, Brodsky V, Péntek M, Gulácsi L, Ruzsa G, Hidvégi B, *et al.* Is the DLQI appropriate for medical decision-making in psoriasis patients? *Arch Dermatol Res.* 2018;310:47–55.
- Patel KR, Singam V, Vakharia PP, Chopra R, Sacotte R, Patel N, *et al.* Measurement properties of three assessments of burden used in atopic dermatitis in adults. *Br J Dermatol.* 2019;180:1083–9.
- Ordóñez J, Palacios Á, Londoño Á, Jiménez S. Medición de la calidad de vida por medio del dermatology life quality index en pacientes con psoriasis: Una revisión sistemática. *Rev Asoc Colomb Dermatol Cir Dermatológica.* 2013;21:305–13.
- Jones-Caballero M, Peñas PF. Calidad de vida (II). Calidad de vida en dermatología. *Actas Dermosifiliogr.* 2002;93:481–9.
- Smith EV, Wakely MB, de Kruif REL, Swartz CW. Optimizing rating scales for self-efficacy (and other) research. *Educ Psychol Meas.* 2003;63:369–91.
- Teresi JA. Different approaches to differential item functioning in health applications: Advantages, disadvantages and some neglected topics. *Med Care.* 2006;44:S152–70.
- Stelmack J, Szlyk JP, Stelmack T, Babcock-Parziale J, Demers-Turco P, Williams RT, *et al.* Use of rasch person-item map in exploratory data analysis: A clinical perspective. *J Rehabil Res Dev.* 2004;41:233.
- Mørk C, Wahl A, Moum T. The norwegian version of the dermatology life quality index: A study of validity and reliability in psoriatics. *Acta Derm Venereol.* 2002;82:347–51.
- Vera M. Significado de la calidad de vida del adulto mayor para sí mismo y para su familia. *An Fac Med.* 2007;68:284–90.
- Cosco TD, Kaushal A, Richards M, Kuh D, Stafford M. Resilience measurement in later life: A systematic review and psychometric analysis. *Health Qual Life Outcomes.* 2016;14:16.
- De León Ricardi CA, García Méndez M. Escala de Rosenberg en población de adultos mayores. *Cienc Psicológicas.* 2016;119–27.
- Ribeiro CC, Neri AL, Yassuda MS. Semantic-cultural validation and internal consistency analysis of the purpose in life scale for brazilian older adults. *Dement Neuropsychol.* 2018;12:244–9.
- Twiss J, Meads DM, Preston EP, Crawford SR, McKenna SP. Can we rely on the dermatology life quality index as a measure of the impact of psoriasis or atopic dermatitis? *J Invest Dermatol.* 2012;132:76–84.
- Ofenloch R, Diepgen T, Weisshaar E, Elsner P, Apfelbacher C. Assessing health-related quality of life in hand eczema patients: How to overcome psychometric faults when using the dermatology life quality index. *Acta Derm Venereol.* 2014;94:658–62.
- Liu Y, Li T, An J, Zeng W, Xiao S. Rasch analysis holds no brief for the use of the dermatology life quality index (DLQI) in chinese neurodermatitis patients. *Health Qual Life Outcomes.* 2016;14:17.
- He Z, Martire R, Lu C, Liu H, Ma L, Huang Y, *et al.* Rasch analysis of the dermatology life quality index reveals limited application to chinese patients with skin disease. *Acta Derm Venereol.* 2018;98:59–64.
- Rencz F, Mitev AZ, Szabó Á, Beretzky Z, Poór AK, Holló P, *et al.* A rasch model analysis of two interpretations of 'not relevant' responses on the dermatology life quality index (DLQI). *Qual Life Res.* 2021;30:2375–86.