

INVESTIGATIVE REPORT

Psychometric Properties of the Dermatology Life Quality Index (DLQI) in 900 Italian Patients with Psoriasis

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The Dermatology Life Quality Index (DLQI) is one of the most frequently used questionnaires to evaluate the impact of dermatological diseases on patients' lives. This study aimed to assess the reliability and validity of the instrument and to test its unidimensionality in a large sample of patients with psoriasis ($n=976$) hospitalized at IDI-IRCCS, Rome, Italy. Nine hundred patients completed the DLQI, the Psoriasis Disability Index (PDI) and the Skindex-29 (response rate 92%). The internal consistency of the DLQI was high (Cronbach's $\alpha=0.83$). Evidence of convergent validity was provided by high ($r=0.64-0.81$) correlations between the DLQI, the PDI, and the functioning and emotions scales of Skindex-29. Exploratory factor analysis indicated the presence of four different principal common factors. Confirmatory factor analysis showed a clear second-order factor structure, with a homogeneous second-order factor underlying the four primary-surface factors. This study confirms that the DLQI is a reliable and valid instrument to assess patient-perceived impact of skin disease. Also, it supports the unidimensionality of the DLQI and hence corroborates the common practice of using the total score. *Key words: factor analysis; item response theory; questionnaire; skin diseases.*

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The effects of skin disease on patients' lives can be profound, and may interfere with all aspects of life. Skin diseases affect many dimensions of quality of life and affect daily physical and social activities, and psychological well-being (1–9). The assessment of the impact of skin diseases is important in clinical decision making for designing and selecting suitable health care programmes. The need to evaluate the impact of dermatological diseases on patients' lives has led to the development of several questionnaires to measure health-related quality of life (HRQOL) (10–16). One of the most frequently used is the Dermatology Life Quality Index (DLQI) (17, 18). It is a questionnaire for the overall evaluation of dermatological patients

irrespective of their diagnosis (17). Initially developed at the dermatological clinic of the University Hospital of Wales, the instrument has also been used in the USA (19), and it has been translated into several European languages (2, 20–22). Recently, it has demonstrated satisfactory responsiveness to change in clinical status in patients with psoriasis (23).

The objective of the present study, which is part of a larger research project on psychosocial well-being of patients with psoriasis, was to deepen the understanding of the psychometric characteristics of the DLQI. In particular, we were interested in testing whether the instrument is really unidimensional, as the common practice of reporting only the total score implicitly assumes.

MATERIALS AND METHODS

Patients and investigational settings

Consecutive patients with psoriasis were recruited from February 2000 to February 2002 at the inpatient wards of IDI-IRCCS, a large dermatological hospital located in Rome, Italy. The study protocol was approved by the Institutional Review Board, within the framework of the IDI Multipurpose Psoriasis Research On Vital Experiences (IMPROVE) research project.

The inclusion criteria were: written informed consent; first admission at IDI-IRCCS; at least 18 years of age; at least 5 years of education; absence of severe mental or physical illness.

Within 24–48 hours from admission, patients completed a questionnaire on sociodemographic variables and the research questionnaires.

Instruments

The DLQI (17) is a self-administered questionnaire to measure HRQOL over the previous week in patients with skin diseases. It consists of 10 items covering symptoms and feelings (items 1 and 2), daily activities (items 3 and 4), leisure (items 5 and 6), work and school (item 7), personal relationships (items 8 and 9) and treatment (item 10). Each item is scored on a 4-point scale, indicating 'not at all', 'a little', 'a lot' and 'very much'. Item scores are summed to yield a total score, with higher scores indicating greater impairment in HRQOL. When one answer was missing, it was substituted with the average patient's scores on the remaining items. Questionnaires with two or more missing items were excluded from the analysis. We used the official Italian version, kindly provided by Professor A. Finlay.

The Psoriasis Disability Index (PDI) (14) is a self-administered questionnaire which consists of 15 questions covering aspects of functional disability due to psoriasis. The

questions are grouped under five headings: daily activities, work, personal relationships, leisure and treatment. The total score is obtained by summing all item scores. Higher scores indicate greater disability.

The Skindex-29 (12) is a self-administered questionnaire that has been specifically designed for measuring HRQOL in dermatological patients. It consists of 29 items, scored on a 5-point scale, and it gives three scale scores, assessing burden of symptoms, social functioning and emotional state, respectively. Higher scores indicate greater impact of skin disease on quality of life. We used the validated Italian version (24).

The staff dermatologists evaluated severity of psoriasis using the Psoriasis Area and Severity Index (PASI) (25–27). Information was also collected on demographic data, and on other factors of clinical interest (e.g. clinical type and location of the disease, personal history of psoriasis).

Data reduction and statistical analysis

To assess internal consistency of the DLQI, Cronbach's alpha coefficient and item-total correlations were computed. Pearson's correlation coefficients between DLQI total score and PDI and Skindex scale scores were computed to test convergent validity. We hypothesized that the DLQI would be very highly correlated with the PDI (which has been developed by the same authors and taps very similar constructs), highly correlated with the functioning and emotions scales of Skindex-29 (each covering narrower aspects of impaired HRQOL), and moderately correlated with the Skindex-29 symptoms scale (as the DLQI includes only one item specifically covering symptoms). Then, we studied the factor structure of the DLQI with a multidimensional two-parameter latent trait model as implemented in the MPLUS software (28), based on a statistical model developed by Muthén (29, 30). Testing for the unidimensionality of a questionnaire such as the DLQI is a recommendable step to evaluate if using a total score is adequate. A two-parameter model was preferred because indices of unidimensionality based on a one-parameter latent trait model such as Rasch's model suffer from an inability to detect multidimensionality and might inappropriately support unidimensionality (31). Two-parameter models differ from Rasch's model because they include a second parameter on item discriminatory power in addition to the parameter on item difficulty. First, an exploratory factor analysis (EFA) was performed, followed by a confirmatory factor analysis (CFA).

To assess model fit, we used several fit indices. The Tucker-Lewis index (TLI) and Bentler's comparative fit index (CFI) compare the estimated model with an independent model in which variables are assumed to be completely unrelated. High values (>0.95) are indicative of a good-fitting model. We also used the standardized root mean square residual (RMRS), which is the square root of the mean squared differences between the observed variances and covariances and the corresponding estimated variances and covariances. The smaller the RMRS, the better the fit. Values of 0.05 or less are desired. Finally, we used the root mean square error of approximation (RMSEA), which incorporates the discrepancy function criterion (comparing observed and predicted covariance matrices) and the parsimony criterion (parsimonious models are those with relatively few parameters to estimate in relation to the number of variables and relationships in the model). Good-fitting models have an RMSEA of 0.05 or less.

RESULTS

Patient characteristics

Of 976 eligible patients, 40 refused to participate and 36 were excluded from the analysis because of 2 or more missing answers on the DLQI. A comparison of patients included in the study and patients who returned an incomplete DLQI showed no significant differences regarding gender, marital status, severity of skin condition and clinical type. However, the former were more educated, younger and had a lower age at onset.

The analysis was carried out on a total of 900 patients (92%). They were aged between 18 and 88 years (mean 44 ± 16.2). Nearly 60% of patients were men, 60% were married, 57% had more than 8 years of education and 54% were employed. The mean duration of illness was 12.1 ± 11.9 years. The mean age at psoriasis onset was 33 ± 17.2 years. The primary clinical type was generalized plaque psoriasis (54%). The other clinical types of psoriasis were localized plaque psoriasis (18%), guttate (14%), palmoplantar (8%), generalized and localized pustular (3%), other (e.g. erythrodermic and nail psoriasis, 4%). The mean clinical severity of psoriasis as assessed by PASI was 8.2 ± 5.6 (range 0.4–54; median 7.1).

Distribution, reliability and convergent validity of DLQI total score

The distribution of DLQI total scores was nearly normal. The mean score was 8.8 ± 6.1 , ranging from 0 to 30. The 25th, 50th and 75th percentiles were 4, 8 and 12, respectively. Only 2% of patients had no measurable negative health state (DLQI total score=0).

The frequency of 'not relevant' responses was lower than 1% for all items except item 6 covering sports activities (26%). This result was expected in our culture, especially given the high prevalence (20%) of people aged more than 60.

The internal consistency of the DLQI was found to be satisfactory. Cronbach's alpha was 0.83, indicating a high degree of internal consistency; the corrected item-total correlations ranged from 0.40 to 0.70.

The correlations between the DLQI and the PDI and Skindex-29 functioning, emotions and symptoms scales were 0.81, 0.72, 0.64 and 0.56, respectively.

Dimensionality of the DLQI

Exploratory factor analysis. Table I summarizes the fit indexes for the different solutions. All fit indexes suggested that a 4-factor solution was to be preferred. The four factors were rotated with the promax oblique method. The rotated pattern matrix and factor correlation matrix are reported in Table II, where factor loadings >0.40 are highlighted in bold type.

The factor solution accounted for 61.1% of total variance. The first factor explained 17.0% of variance

Table I. Goodness of fit indexes of exploratory factor analysis. The best solution is given boldface

	χ^2	df	<i>p</i>	RMSEA	RMSR	Tucker and Lewis index	Comparative fit index
0 Factors	3696.314	45	0.0000	0.300	0.4236
1 Factor	308.013	35	0.0000	0.093	0.1766	0.904	0.925
2 Factors	162.896	26	0.0000	0.076	0.0955	0.935	0.963
3 Factors	80.769	18	0.0000	0.062	0.0541	0.957	0.983
4 Factors	18.141	11	0.0783	0.027	0.017	0.992	0.998

df, degrees of freedom; RMSEA, root mean square error of approximation; RMSR, root mean square residual.

Table II. Rotated pattern matrix and factor correlation matrix

	Factor loadings				
	f1	f2	f3	f4	h ²
Symptoms	0.66	-0.13	0.17	-0.08	0.45
Feelings	0.67	0.23	-0.10	0.08	0.63
Daily activity, item 3	0.44	0.23	0.36	-0.07	0.66
Daily activity, item 4	0.37	0.39	-0.10	0.09	0.44
Leisure	0.30	0.74	-0.01	0.02	0.86
Sport	-0.14	0.61	0.23	-0.03	0.45
Work/school	0.01	0.10	0.78	-0.03	0.67
Personal relationships	-0.01	-0.01	-0.02	1.06	1.00
Social relationships	0.03	0.09	0.06	0.62	0.52
Treatment	0.17	-0.09	0.41	0.19	0.35
Exploratory variance	16.99	15.51	12.19	16.42	61.10

Factor correlations				
	f1	f2	f3	f4
f1	1			
f2	0.461	1		
f3	0.541	0.482	1	
f4	0.522	0.549	0.434	1

h²=communality. Factor loadings >0.40 are highlighted in bold type.

and was loaded by the items related to symptoms, feelings and daily activities. The second factor explained 15.5% of total variance and was loaded by the items related to leisure and sport activities. The third factor explained 12.2% of total variance and was loaded by the items related to work/school and 'treatment'. The fourth factor explained 16.4% of total variance and was loaded by the items related to

personal and social relationships. The factors were substantially correlated, with coefficients ranging from 0.43 to 0.55. This level of correlation among factors suggests the presence of a second-order dimension, underlying the four first-order factors. As noted by Hattie (31), 'it is quite reasonable to find a second-order factor underlying a set of correlations between first-order factors and then make claims regarding unidimensionality'. To explore the second-order factor structure of the DLQI, CFA was performed.

Confirmatory factor analysis. The CFA was performed with the approach developed by Jöreskog & Sörbom (32). All models postulated a single second-order factor influencing all first-order factors. The first model showed quite adequate goodness-of-fit indices (Table III). However, many parameters resulted in estimates statistically not significantly different from 0. Hence, a second model where these parameters were fixed at 0 was tested. The fit indices were adequate, and the difference between the second model and the first model was not significant (χ^2 diff(7)=12.33, *p*=0.09). Two alternative models were tested. In the third ('simple structure' model), all secondary loadings were fixed at 0. This model, although more parsimonious than the second, showed worst fit indices, and the results were significantly different from model 1 (χ^2 diff(16)=84.30, *p*<0.001). In the fourth ('orthogonal' model), we addressed directly the possibility that first-order factors were not correlated, by fixing factor correlations to 0 and not positing a second-order factor. This model resulted in a very bad fit.

Therefore, the second model appeared to be the best because it was the more parsimonious. Table IV presents the parameter estimates of this model. As can be seen, the results in Table IV replicate substantially those reported in Table II.

Table III. Goodness of fit indexes of exploratory factor analysis (EFA)

	χ^2	df	<i>p</i>	RMSEA	RMSR	TLI	CFI
Model 1: EFA in CFA	30.88	13	0.0035	0.039	0.025	0.9830	0.995
Model 2: EFA in CFA respecified	43.21	20	0.0019	0.036	0.028	0.986	0.994
Model 3: Simple structure	115.18	29	0.0000	0.057	0.061	0.963	0.976
Model 4: EFA in CFA orthogonal	657.91	24	0.0000	0.171	0.252	0.674	0.826

df, degrees of freedom; RMSEA, root mean square error of approximation; RMSR, root mean square residual; TLI, Tucker and Lewis Index; CFI, comparative fit index; CFA, confirmatory factor analysis.

Table IV. First-order and second-order pattern matrices from the confirmatory factor analysis

	First-order factor loadings				
	f1	f2	f3	f4	h ²
Symptoms	<u>0.71</u>	0.00	0.00	0.00	0.50
Feelings	<u>0.45</u>	0.29	0.00	0.18	0.60
Daily activities, item 3	0.33	0.23	0.42	0.00	0.65
Daily activities, item 4	0.21	0.40	0.00	0.16	0.43
Leisure	0.00	<u>0.98</u>	0.00	0.00	0.97
Sport	-0.22	0.50	0.31	0.00	0.40
Work/school	0.00	0.00	<u>0.82</u>	0.00	0.67
Personal relationships	0.00	0.00	0.00	<u>0.95</u>	0.90
Social relationships	0.00	0.00	0.00	0.78	0.61
Treatment	0.23	-0.15	0.40	0.22	0.35
	Second order factor loadings				
	f5	h ²			
f1	<u>0.63</u>	0.40			
f2	0.87	0.75			
f3	0.72	0.52			
f4	0.72	0.51			

h²=communality. Underlined coefficients were fixed to 1. Coefficients in italics were fixed at 0. Loadings 0.40 or higher are given in bold type.

DISCUSSION

The results of this study confirmed that the DLQI is a reliable and valid instrument. While our previous study documented fair stability of scores over time in clinically unchanged patients and responsiveness to clinically meaningful change (23), the present study provided evidence of internal consistency, as both Cronbach's alpha and item-total correlations were high. Also, the pattern of correlations with the PDI and the Skindex-29 scales was as hypothesized, and this adds to available evidence of convergent validity for the DLQI. There was a very high correlation with the PDI, which is a psoriasis-specific instrument covering very similar areas of difficulty to the DLQI, and moderate-to-high correlations with the scales of the Skindex-29, each one covering narrower aspects of impaired HRQOL.

In our exploratory factor analysis, we found a 4-factor solution that is largely consistent with the hypothesized domains of HRQOL assessed by the instrument. The only unexpected result was that item 10 ('how much of a problem has the treatment for your skin been, for example by making your home messy, or by taking up time?') loaded together with items related to work and school. Possibly, this happened because in the Italian version of the DLQI this item gives more emphasis to the 'messiness of the home' itself, rather than to treatment as a cause of problems.

When using the DLQI, researchers usually report only the total score, in spite of the fact that it

covers several different domains, as also documented by our exploratory factor analysis. This practice implicitly assumes unidimensionality of the instrument. However, to our knowledge, only preliminary evidence that the instrument is unidimensional has been collected (21). The point is that neither the percentage of explained variance of the first factor before rotation nor Cronbach's alpha can be considered as reliable indexes of unidimensionality (31).

In our second-order confirmatory factor analysis, we used a two-parameter model to test for unidimensionality. The results clearly documented the presence of a latent dimension underlying the first-order factors. Hence, this study clearly supports the unidimensionality of the DLQI.

There is no contradiction between the documented unidimensionality of the DLQI and the fact that it explicitly covers several domains of HRQOL. That the instrument is unidimensional simply means that there is a higher-order construct that accounts for all patients' responses and includes both psychosocial effects and physical effects of skin disease on quality of life. In other words, the negative influence of skin disease is consistent across the various domain of patients' lives.

A limitation of this study is that only inpatients were included. However, the hospitalization pattern at IDI-IRCCS is such that our results could probably be generalized to dermatological outpatients in other health systems where hospitalization for skin diseases is rarer. In fact, at the time data were collected, many patients who came from more disadvantaged regions were hospitalized despite having skin diseases of mild or moderate severity in order to undergo diagnostic procedures and treatments that were not readily available in the regions where they lived. In fact, in our sample there were enough patients ($n=230$) with diseases of mild severity ($PASI \geq 5$) to perform an additional test of convergent validity, although not unidimensionality, in this subgroup. The results were very similar to those obtained in the whole sample, and this corroborates the generalizability of our findings to outpatients.

As recently remarked, the severity of psoriasis is, first and foremost, a HRQOL issue (33). However, although HRQOL measures had already been introduced in dermatology in the early 1990s (34), they are still under-utilized. The DLQI is a short instrument, easy to complete and to score, that might be extremely useful even in busy clinical practices to gather information about patients' well-being and quality of life. In a previous study, we documented that it is able to detect meaningful changes in HRQOL and thus to measure the effects of treatment and monitor the disease course (23). The present study confirmed that it is a reliable and valid instrument, and that it is justified to report the results as a summary score as far as psoriasis is concerned. Further studies are needed to test the unidimensionality of the instrument in other skin conditions.

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