ORIGINAL REPORT

Correlation between Dermatology Life Quality Index and Psoriasis Area and Severity Index in Patients with Psoriasis: A Cross-sectional Global Healthcare Study on Psoriasis

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Quality of life impairment in dermatology patients and severity of psoriasis are quantified by the Dermatology Life Quality Index (DLQI) and the Psoriasis Area and Severity Index (PASI), respectively. The aim of this study is to compare the correlation between PASI and DLQI in patients from different geographical areas and to identify predictors of high DLQI across geographical regions. Correlations between PASI and DLQI were evaluated using Spearman's rank correlation tests and quantile regression. The study included 1,158 patients with psoriasis, with a median (interquartile range) PASI and DLQI of 6.0 (3.0–12.0) and 8.0 (4.0–15.0), respectively. Correlations were demonstrated between PASI and DLQI, both overall and stratified by geographical region. Quantile (median) regression yielded coefficients of 0.75 (95% confidence interval (95% CI) 0.62, 0.88) for Switzerland, 0.50 (95% CI 0.42, 0.58) for Latin America, 0.34 (95% CI 0.16, 0.51) for Asia, and 0.31 (95% CI 0.08, 0.53) for the USA. Current age, age at diagnosis, sex, body mass index, and psoriasis arthritis affected DLQI in Latin America, while education had an impact among patients treated in Switzerland. Few countries were included within each continent; hence, more data from different countries are necessary for generalizability. The study showed correlations between PASI and DLQI among patients in all included geographical regions. The patients' characteristics affecting DLQI vary worldwide.

Key words: correlation; cross-sectional study; DLQI; GHSP; PASI; psoriasis.

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SIGNIFICANCE

This study evaluates the correlation between Psoriasis Area and Severity Index and Dermatology Life Quality Index scores on a global scale. Multiple covariates were significantly associated with Dermatology Life Quality Index among patients in Switzerland and Latin America, and a correlation was found between Dermatology Life Quality Index and Psoriasis Area and Severity Index in all countries. This indicates that treatment guidelines should possibly vary with geographical region, in order to best improve patients' quality of life.

Psoriasis is a chronic inflammatory skin disease with a approximate prevalence ranging between < 1% and 10%, depending on the geographical region (1). The prevalence is especially high in regions with older populations and in high-income countries, such as western/central Europe and North America (2).

Psoriatic arthritis (PsA) affects approximately 20% of patients with psoriasis (3), but other comorbidities, such as diabetes, cardiovascular diseases, and depression, are also associated with psoriasis (4, 5). Impairment of life quality among patients with PsA is often severe (6, 7), and improvements in the severity of psoriasis are associated with better general well-being (8, 9).

There are several treatment options for psoriasis, which depend on the severity burden (impairment) of the disease and are selected according to guidelines (10–13). In recent years, several different biologics have been developed with high efficacies and favourable safety profiles. Many patients achieve full or almost full skin clearance when treated with biologics, which often leads to considerable improvement in their quality of life (14). However, access to modern treatment, and impairment due to comorbidities, vary enormously worldwide (15). The availability of treatment resources is especially limited in low-income countries and for people with low socio-economic status.

The Psoriasis Area and Severity Index (PASI) is the most widely used measure of the objective severity of

psoriasis symptoms. Both the body surface area (BSA) that is affected by psoriasis, as well as degrees of redness, swelling, and scaliness, contribute to a higher score. The PASI score ranges from 0 to 72, with a score higher than 10 corresponding to moderate-to-severe psoriasis.

The Dermatology Life Quality Index (DLQI) (16) is a subjective measure of the psychological burden, i.e. the impairment of quality of life related to psoriasis and other dermatological diseases. The DLQI is determined by a 10-item questionnaire. The index ranges from 0 to 30, with values above 10 corresponding to a large effect on the patient's quality of life. The questionnaire includes questions about feelings, ability to perform daily activities, leisure, work/school, personal relationships, and treatment.

The correlation between PASI and DLQI is non-linear and, hence, the use of effective treatment options, such as biologics, can greatly improve the quality of life of patients (10, 14, 17–20). However, the relationship between PASI and DLQI for patients treated with multiple psoriasis treatments across different geographical areas remains unexplored. Therefore, cultural differences may influence how the severity of the disease affects the quality of life of patients.

Knowledge about the area-specific relationship between the psychological burden of disease and the severity of psoriasis signs and symptoms may be useful in the development of treatment guidelines across geographical regions.

This study investigated and compared the correlation between the objective severity of psoriasis assessed by dermatologists (using the PASI) and the psychological disease burden experienced by patients (using DLQI) from different geographical regions worldwide. In addition, the study investigated the influence of various predictor variables, such as age and sex, on the life quality of patients with psoriasis.

MATERIALS AND METHODS

Data sources

The Global Healthcare Study on Psoriasis (GHSP) is a multi-country, multi-centre, longitudinal observational study that collects cross-sectional data. This research project is an ongoing international, global survey performed since January 2020 in multiple countries across several continents (15, 21). Socio-demographic and psoriasis-related disease and treatment data were obtained from 2 specialized dermatology centres in Europe (Switzerland), 31 in Latin America (Brazil and Chile), 4 in Asia (China and Singapore), and 1 in North America (USA). Adult patients with a dermatologist-verified diagnosis of psoriasis were included in the GHPS data set if they agreed to participate.

The GHSP survey questions were comparable to those in European registries, such as the Swiss Dermatology Network for Targeted therapies (SDNTT), the British Association of Dermatologists Biologics and Immunomodulators Register (BADBIR), and the German Psoriasis Registry (PsoBest).

General patient demographics, such as sex, current age, age at diagnosis, educational background, ethnicity, status of concomitant PsA, and body mass index (BMI) were included. Furthermore, the severity of psoriasis was documented based on PASI, DLQI, and BSA as assessed by dermatologists or other healthcare professionals. Previous and current treatments were recorded in the categories "topical", "phototherapy", "non-biologic systemics", and "biologics".

The survey comprised 48 items resulting in binary variables (e.g. sex and status of concomitant PsA), categorical variables with multiple categories (e.g. previous/current treatment and educational background), and continuous variables (e.g. age and BMI). This study included all data available in the GHPS at the time of analysis.

Statistical analysis

Descriptive statistics are shown as numbers and percentages for categorical variables and median and interquartile ranges (IQR) for continuous variables.

Correlations between PASI and DLQI were assessed with Spearman's rank correlation tests. Results were reported as correlation coefficients and *p*-values, indicating the strength and significance of the correlation, respectively. This analysis was performed both overall on the entire dataset, and stratified by geographical region.

Furthermore, quantile regression was performed with DLQI as the dependent variable and PASI as the independent variable, investigating the effect of PASI on DLQI. The model was applied overall, and for each geographical region separately. Crude results were obtained in addition to results based on models with several covariates included. Patient- and disease-specific variables were included unless they correlated highly with other variables (e.g. BSA was excluded because of the collinearity with PASI).

Regression coefficients were estimated and presented with 95% confidence intervals (95% CIs) for the 0.25, 0.5, and 0.75 quantiles, to investigate the effect of PASI on DLQI for patients with low, median, and high DLQI scores. The quantile regressions were visualized with regression lines for the 0.5 and 0.75 quantiles. For the model including multiple covariates, *p*-values were also reported. A significance level of 0.05 was used and *p*-values were adjusted for multiple testing using the Benjamini-Hochberg procedure.

Moreover, the regression coefficients were visualized for a range of different quantiles of the DLQI distribution and compared across geographical areas.

Data analysis was performed in Python version 3.7.6 including relevant libraries (22–24).

RESULTS

A total of 1,158 psoriasis patients were included (54.7% males, 19.4% with concomitant PsA) (397 from Switzerland, 580 from Latin America, 130 from Asia, and 51 from the USA). The median and interquartile ranges (IQR) of ages at diagnosis and at the time of visit were 31.0 (20.0–44.0) years and 48.0 (36.0–59.0), respectively. Median (IQR) PASI and DLQI scores were 6.0 (3.0–12.0) and 8.0 (4.0–15.0), respectively. Most patients were treated with topicals (90.8%) and non-biologic systemics (66.8%), while slightly less than half of the patients were treated with phototherapy (46.4%) and biologics (41.2%) (**Table I**).

Overall, the coefficient based on a Spearman's correlation test was 0.53 ($p < 0.001$), indicating a moderate correlation between DLQI and PASI. When stratifying by

Table I. Patient characteristics for all patients and stratified by geographical location

Characteristics	Overall	Switzerland	Latin America	Asia	USA
Number of patients	1158	397	580	130	51
Male, *n* (%)	633 (54.7)	232 (58.4)	294 (50.7)	77 (59.2)	30 (58.8)
Age at diagnosis, years, median (IQR)	31.0 (20.0–44.0)	29.0 (19.0–44.0)	32.0 (21.0–45.0)	29.0 (20.0–39.0)	39.0 (28.0–52.0)
Age at visit, years, median (IQR)	48.0 (36.0–59.0)	47.0 (34.0–58.0)	48.0 (36.0–60.0)	42.0 (32.2–53.8)	56.0 (46.0–65.0)
Education, *n* (%)					
University (complete)	317 (27.4)	47 (11.8)	208 (35.9)	46 (35.4)	16 (31.4)
University (some)	96 (8.3)	9 (2.3)	63 (10.9)	16 (12.3)	8 (15.7)
Secondary (complete)	491 (42.4)	307 (77.3)	128 (22.1)	41 (31.5)	15 (29.4)
Secondary (some)	119 (10.3)	28 (7.1)	67 (11.6)	19 (14.6)	8 (15.7)
Primary (complete)	76 (6.6)	4 (1.0)	60 (10.3)	5 (3.8)	7 (13.7)
Primary (some)	51 (4.4)	2 (0.5)	47 (8.1)	2 (1.5)	0 (0)
No traditional/other	7 (0.6)	0 (0)	6 (1.1)	1 (0.8)	0 (0)
Ethnicity, *n* (%)					
White	626 (54.1)	333 (83.9)	280 (48.3)	1 (0.8)	12 (23.5)
Hispanic/Latino	280 (24.2)	10 (2.5)	243 (41.9)	0 (0)	27 (52.9)
Asian	166 (14.3)	20 (5.0)	9 (1.6)	129 (99.2)	8 (15.7)
Black/African	49 (4.2)	7 (1.8)	41 (7.1)	0 (0)	1 (2.0)
Middle Eastern	16 (1.4)	16 (4.0)	0 (0)	0 (0)	0 (0)
Middle Eastern, white	6 (0.5)	6 (1.5)	0 (0)	0 (0)	0 (0)
Hispanic/Latino, white	3 (0.3)	3 (0.8)	0 (0)	0 (0)	0 (0)
Indigenous	4 (0.3)	1 (0.3)	2 (0.3)	0 (0)	1 (2.0)
Other	3 (0.3)	1 (0.3)	0 (0)	0 (0)	2 (3.9)
Body mass index, mean (SD)	28.1 (11.6)	27.4 (7.1)	28.4 (5.5)	28.0 (29.4)	31.4 (6.8)
Psoriatic arthritis, *n* (%)	225 (19.4)	73 (18.4)	122 (21.0)	9 (6.9)	21 (41.2)
PASI, median (IQR)	6.0 (3.0–12.0)	5.0 (2.0–8.0)	9.0 (4.0–14.0)	6.1 (3.7–10.5)	3.3 (1.4–9.0)
DLQI, median (IQR)	8.0 (4.0–15.0)	7.0 (3.0–14.0)	10.5 (5.0–17.0)	6.0 (3.0–10.0)	5.0 (2.0–12.5)
Body surface area, median (IQR)	6.0 (2.0–15.0)	4.0 (2.0–10.0)	10.0 (4.0–20.0)	5.0 (2.0–11.0)	5.0 (2.0–15.0)
Current treatment, *n* (%)					
Topical	1051 (90.8)	385 (97.0)	519 (89.5)	97 (74.6)	50 (98.0)
Phototherapy	537 (46.4)	234 (58.9)	232 (40.0)	49 (37.7)	22 (43.1)
Non-biologic systemics	774 (66.8)	254 (64.0)	439 (75.7)	54 (41.5)	27 (52.9)
Biologic	477 (41.2)	183 (46.1)	200 (34.5)	45 (34.6)	49 (96.1)

IQR: interquartile range; PASI: Psoriasis Area and Severity Index; DLQI: Dermatology Life Quality Index.

geographical region, the coefficients obtained were 0.54 ($p<0.001$) for Latin America, 0.47 ($p<0.001$) for Switzerland, 0.45 ($p<0.001$) for Asia, and 0.41 ($p=0.004$) for the USA (**Table II**).

Quantile regression with PASI as independent variable yielded coefficients and 95% CIs (Table II). For median regression (a quantile of 0.5) the coefficient for Switzerland was larger than for all other included geographical areas (0.75 (95% CI 0.62, 0.88) compared with 0.50 (95% CI 0.42, 0.58) for Latin America, 0.34 (95% CI 0.16, 0.51) for Asia, and 0.31 (95% CI 0.08, 0.53) for the USA). This indicates a stronger effect of PASI on the median DLQI in Switzerland compared with the other regions.

Similarly, the coefficient obtained from performing 0.75 quantile regression was larger for Switzerland compared with both Latin America and Asia (0.84 (95% CI 0.67, 1.02) compared with 0.50 (95% CI 0.41, 0.59) for Latin America and 0.40 (95% CI 0.20, 0.61) for Asia), indicating that PASI affects the 0.75 quantile of DLQI more strongly in Switzerland compared with Latin America and Asia (Table II).

The *p*-values obtained from the quantile regression with multiple covariates indicated a statistically significant positive correlation between PASI and median DLQI for all geographical regions (**Table III**). In addition, education had a significant negative effect on DLQI in Switzerland, but not in any other region. Among patients in Latin America, current age had a statistically significant negative effect on DLQI, while age at diagnosis and BMI had positive effects on DLQI. Being male and having PsA are negatively and positively associated with DLQI, respectively. No covariates affected DLQI among patients treated in Asia and the USA.

Regression lines are shown for median and the 0.75 quantile regression models, where the slope of the lines

Table II. Correlation coefficients and *p*-values based on the Spearman's rank correlation test overall and stratified by country

Geographical region	Spearman's correlation coefficient (*p*-value)	Regression coefficient (95% CI)		
		0.25 quantile regression	0.5 quantile regression	0.75 quantile regression
Overall	0.53 (<0.001)	NA	NA	NA
Latin America	0.54 (<0.001)	0.42 (0.31, 0.54)	0.75 (0.62, 0.88)	0.84 (0.67, 1.02)
Switzerland	0.47 (<0.001)	0.42 (0.35, 0.50)	0.50 (0.42, 0.58)	0.50 (0.41, 0.59)
Asia	0.45 (<0.001)	0.24 (0.05, 0.42)	0.34 (0.16, 0.51)	0.40 (0.20, 0.61)
USA	0.41 (0.004)	0.34 (0.17, 0.50)	0.31 (0.08, 0.53)	0.66 (0.39, 0.94)

Coefficients and 95% confidence intervals (95% CIs) based on quantile regression with 3 different quantiles and Psoriasis Area and Severity Index (PASI) as independent variable.
95% CI: 95% confidence interval. NA: Not applicable.

Table III. Coefficients with 95% confidence intervals (95% CIs) and *p*-values based on quantile regression with several variables included as independent variables in addition to Psoriasis Area and Severity Index (PASI)

	Switzerland		Latin America		Asia		USA	
	Coefficient (95% CI)	*p*-value	Coefficient (95% CI)	*p*-value	Coefficient (95% CI)	*p*-value	Coefficient (95% CI)	*p*-value
PASI	0.70 (0.57, 0.84)	**<0.001**	0.53 (0.46, 0.59)	**<0.001**	0.30 (0.13, 0.47)	**0.003**	0.39 (0.15, 0.64)	**0.009**
BMI	−0.04 (−0.15, 0.07)	0.59	0.22 (0.12, 0.33)	**<0.001**	0.02 (−0.02, 0.06)	0.44	0.33 (−0.01, 0.66)	0.11
Age (diagnosis)	−0.01 (−0.07, 0.06)	0.92	0.07 (0.02, 0.12)	**0.03**	0.07 (−0.04, 0.18)	0.37	−0.04 (−0.22, 0.14)	0.76
Age (current)	−0.09 (−0.16, −0.01)	0.06	−0.10 (−0.16, −0.04)	**0.003**	−0.05 (−0.16, 0.06)	0.51	−0.07 (−0.31, 0.16)	0.66
Sex	−1.64 (−3.32, 0.03)	0.11	−3.34 (−4.46, −2.22)	**<0.001**	−1.57 (−3.90, 0.75)	0.33	−5.03 (−9.82, −0.23)	0.10
PsA	−0.85 (−2.94, 1.25)	0.57	1.73 (0.37, 3.09)	**0.04**	−0.07 (−4.71, 4.58)	0.99	2.56 (−2.45, 7.57)	0.45
Education	−1.27 (−2.27, −0.26)	**0.04**	−0.08 (−0.42, 0.27)	0.76	−0.46 (−1.32, 0.39)	0.44	−0.01 (−1.73, 1.72)	0.99

BMI: body mass index; PsA: psoriasis arthritis. Statistical significant differences are highlighted with bold *p*-values.

represents the regression coefficients for each geographical region (**Fig. 1**). Furthermore, the regression coefficients as a function of a wider range of quantiles of the DLQI distribution were estimated and visualized (**Fig. 2**). In general, the coefficients are higher for larger quantiles, indicating a non-linear relationship between PASI and DLQI. Hence, an increase in PASI results in a greater increase in DLQI for patients with an already high value of DLQI. Patients from Switzerland with a DLQI above the 0.25 quantile seems to be more affected by increases in PASI compared with all other geographical regions.

DISCUSSION

This study investigated and compared the correlation between PASI and DLQI across multiple geographical regions based on the GHSP data. Moderate correlations were observed between PASI and DLQI, both overall and individually for each geographical region (Switzerland, Latin America, Asia, and the USA). Furthermore, the study identified important covariates associated with DLQI within patient groups. Education had a significant negative effect on DLQI among patients in Switzerland, whereas BMI, current age, age at diagnosis, sex, and PsA were significantly associated with the median DLQI for patients in Latin America.

Depending on the country of residence and the availability of healthcare resources in the patient's country the sense of quality of life may differ. This includes how psoriasis affects patients' daily lives globally depending on the severity of psoriasis. Increases in PASI had a greater effect on the DLQI for patients from Switzerland compared with all other geographical regions. Across all regions, the effects of a change in PASI on DLQI seems to be greater for patients whose DLQI is already high. The cultural environment may be an influential factor; cultural standards could affect a patient's openness to share their quality of life, feelings, and psychological comorbidities with medical professionals (25, 26). This may explain why patients with psoriasis from different countries demonstrate varying reactions to the DLQI.

It is notable that the study found only moderate correlations between PASI and DLQI, in accordance with the results from a pooled analysis of phase 3 clinical trials (20). This suggests that the quality of life of some patients is severely affected, even though their PASI, as assessed by a dermatologist, is low, while the quality of life of other patients is only mildly impaired even though their PASI is high. Despite the fact that skin clearance with different psoriasis treatments often seems to be associated with greater quality of life (18), a better understanding of regional differences in disease-specific quality of life worldwide is needed to optimize treatment in a personalized way. Better access to appropriate treatment in some geographical regions (21) may improve the burden of disease globally.

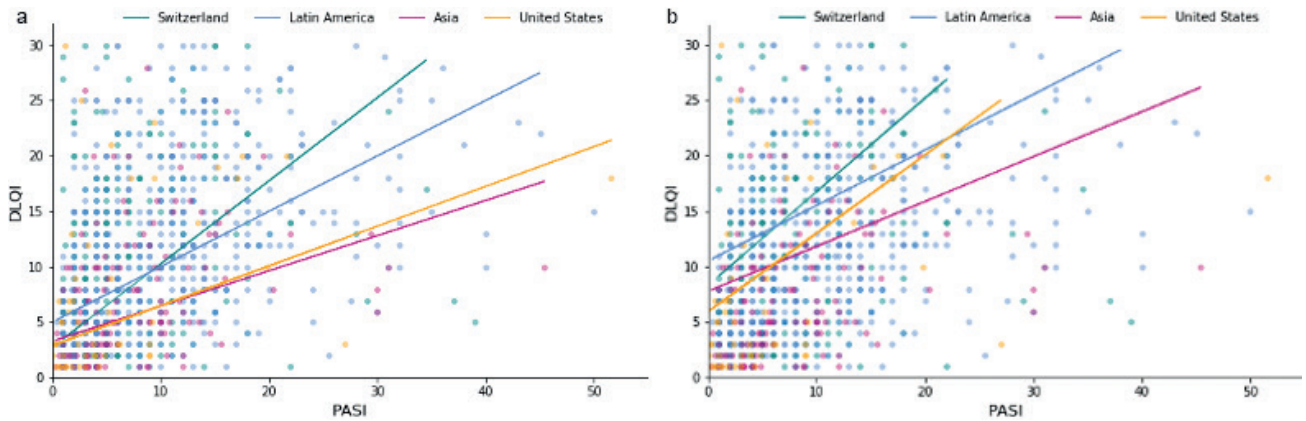

Fig. 1. Regression lines for (a) median regression and (b) 0.75 quantile regression for each geographical region. PASI: Psoriasis Area and Severity Index; DLQI: Dermatology Life Quality Index. All quantities on the axes on the figures are either indexes or coefficients, and are therefore unitless.

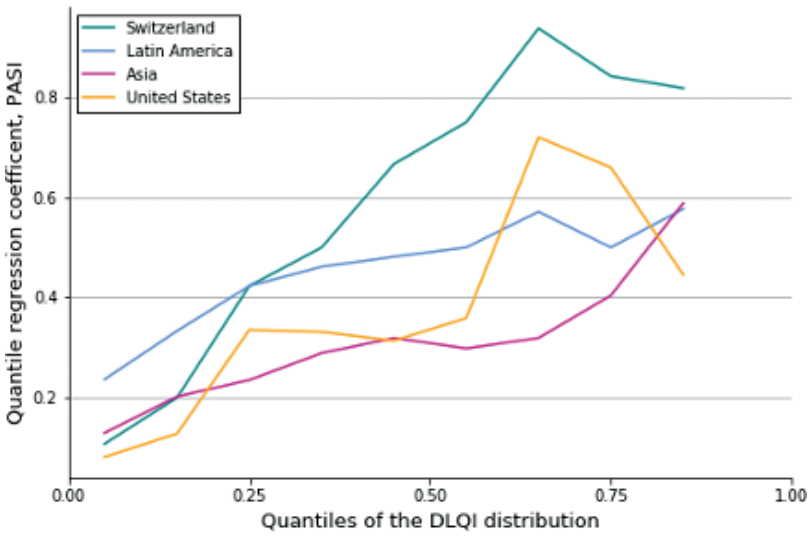

Fig. 2. Visualization of the quantile regression coefficients for Psoriasis Area and Severity Index (PASI) as a function of the quantiles of the Dermatology Life Quality Index (DLQI) distribution. The value of DLQI increases along the x-axis. A larger coefficient indicates a stronger effect of PASI on DLQI.

The regression coefficients are larger for higher quantiles, indicating that a reduction in PASI could result in a considerable improvement in the quality of life of patients. This observation applies especially to patients with severely impaired quality of life, but also to patients with only mildly impaired quality of life. Hence, it would be beneficial for patients to treat their psoriasis with the goal of achieving clear or almost clear skin. This finding is in agreement with the results from a meta-analysis (18) and several other studies (27, 28) revealing that patients with moderate-to-severe psoriasis with a PASI90 response achieve a superior quality of life compared with patients with a PASI75 response (29).

The observed non-linear relationship between PASI and DLQI is in accordance with previous research (30). The non-linearity might result from the DLQI being composed of multiple questions, each ranging between 0 and 3. Therefore, no component in the DLQI questionnaire can contribute more than 3 to the final score, regardless of the severity of the disease.

The current gold standard for effective treatment of moderate-to-severe psoriasis is achieving clear or almost clear skin with a PASI90 response and a DLQI of 0 or 1 (11). However, achieving these treatment objectives on a global scale proves difficult, attributable largely to the disparities in cultural contexts, as well as the non-uniform availability and allocation of treatment resources across different nations. The differences in treatments across geographical regions were probably partly explained by the differences in approval processes and access to specific medication worldwide. Hence, these processes may affect the correlation between PASI and DLQI across counties.

The data collection for the GHSP is an ongoing, and therefore, the dataset will be extended with information from other continents and other countries in the currently included continents.

Strengths and limitations

The main strength of the study is the international nature of the data, which allows for comparison of the effect of disease severity on psychological burden across multiple geographical regions. This is the most comprehensive investigation of the relationship between psoriasis severity and quality of life worldwide utilizing the GHSP dataset.

The analyses of data from the USA are limited by a modest number of patients from this region. As the number of included countries per continent is low, the data may not be well generalizable to the whole continent. However, since the data collection is ongoing, the generalizability can be improved in future research. Since the data are obtained from specialized psoriasis centres, PASI and DLQI values may be slightly higher compared with the general populations of patients with psoriasis in the respective geographical regions.

Conclusion

PASI and DLQI are correlated across geographical areas, and an increase in PASI affects the quality of life more severely in patients from Europe and patients whose quality of life is already highly affected. Different patient characteristics are associated with DLQI across regions. The aim is to use effective treatment regimens in the future, possibly depending on geographical region, in order to improve patient's quality of life and reduce the severity of disease globally.

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The study was approved by the local ethics committee (EK2020–00002) and was conducted in compliance with the Declaration of Helsinki and Good Clinical Practice rules.

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