

# Health Related Quality of Life of Rosacea Patients in China Assessed by Dermatology Life Quality Index and Willingness to Pay

Yaqun Huang<sup>1,2,\*</sup>, Sha Yan<sup>1,2,\*</sup>, Hongfu Xie<sup>1</sup>, Ben Wang<sup>1</sup>, Zhixiang Zhao<sup>1</sup>, Yingxue Huang<sup>1,2</sup>, Ji Li<sup>1,2</sup>

<sup>1</sup>Department of Dermatology, Xiangya Hospital, Central South University, Changsha, People's Republic of China; <sup>2</sup>National Clinical Research Center for Geriatric Disorders, Xiangya Hospital, Central South University, Changsha, People's Republic of China

\*These authors contributed equally to this work

Correspondence: Ji Li; Yingxue Huang, Department of Dermatology, Xiangya Hospital, Central South University, 87 Xiangya Road, Changsha, 410008, Hunan, People's Republic of China, Tel +86 731 8432 7472, Fax +86 731 8432 7128, Email [liji\\_xy@csu.edu.cn](mailto:liji_xy@csu.edu.cn); [huangyingxue1987@163.com](mailto:huangyingxue1987@163.com)

**Purpose:** Rosacea is a chronic inflammatory dermatosis mainly involving facial skin, leading to physical and emotional problems, which greatly affect the quality of life (QoL) of patients. Dermatology Life Quality Index (DLQI) and willingness to pay (WTP) are well-established instruments assessing the health-related quality of life (HRQoL), while very few studies have been focused on this topic about rosacea in China. The present study investigated HRQoL in Chinese rosacea patients.

**Patients and Methods:** This cross-sectional study was conducted on 973 patients with rosacea. Sociodemographic data, clinical features and DLQI were collected, and WTP was assessed by three standardized items. Multivariable logistic analysis was performed to investigate independent factors influencing QoL.

**Results:** A total of 921 questionnaires were accomplished by participants. The mean DLQI score was 11.6 (median 11). Patients were willing to pay an average of € 896.2 (median € 368.1) for complete cure. 33.3% would like to pay more than 20% of their monthly income to achieve sustainable control. There were positive correlations between WTP with DLQI ( $P < 0.05$ ). DLQI could be independently impacted by age (21–30 and 31–40 relative to  $> 50$ , OR = 3.242 and 3.617, respectively), the occupational requirement of appearance (high, OR = 4.410), disease duration ( $< 2$  years, OR = 1.582), edema (OR = 1.844) and severity of flushing, burning, stinging and pruritus (severe, OR = 2.003, 1.981, 2.491, 2.249, respectively). There were no significant associations between WTP and most of the clinical factors.

**Conclusion:** The QoL was greatly impaired and should not be ignored among rosacea patients in China. Patients aged 21–40y, having occupational requirement of appearance, with the disease duration less than 2 years, and suffering severe flushing and related sensitive symptoms were more likely to have severe or very severe limitation of QoL.

**Keywords:** cross-sectional study, quality of life, dermatology, DLQI, WTP

## Introduction

Rosacea is a chronic inflammatory dermatosis that primarily affects the convexities of central face. Manifestations of rosacea include flushing, persistent erythema, papules and pustules, telangiectasia and phymatous changes as well as plaque and edema.<sup>1</sup> The global prevalence of rosacea is 5.46%,<sup>2</sup> while in China the prevalence was reported as 3.48%,<sup>3</sup> and not lower than 3.35% even in the population of adolescents.<sup>4</sup>

Since rosacea predominantly presents in the facial region and affects patients' cosmetic appearance, it frequently interferes with social and occupational interactions.<sup>5</sup> Besides, the accompanying subjective symptoms of rosacea (such as burning, stinging and pruritus) may also reduce patients' quality of life (QoL) or even sleep quality.<sup>6</sup> Another disturbance is the long course of recurrent exacerbations and remissions,<sup>1</sup> which may make patients lose confidence in treatment. Plenty of triggers could cause rosacea to relapse, so patients have to be very careful to modify their productivity and

behavior to avoid the recurrence.<sup>2,7</sup> As a result, rosacea may not be life-threatening, but still result in significant psychosocial and emotional problems due to its unsightly suffering and embarrassing appearance.<sup>8,9</sup> Patients with rosacea often have feelings of stigmatization and stress, more severely, have a higher probability of social phobia, anxiety and depression.<sup>9–11</sup> Nonetheless, clinicians often overlook these problems perceived by patients and focus more on the visible and objective symptoms. This discrepancy may interfere with the treatment satisfaction as the patients usually care more about subjective feelings and psychosocial impact.<sup>12,13</sup> To eliminate this discrepancy, QoL should be considered when the therapy strategy is made.

Generally, the QoL can be evaluated comprehensively with several kinds of instruments, including descriptive and detailed health status instruments such as DLQI, and preference-based methods composing of willingness-to-pay (WTP) and utilities.<sup>14</sup> The Dermatology Life Quality Index (DLQI) is the most extensively used health status instrument in dermatology<sup>20</sup> and is recommended by the ROSacea COnsensus to assess the patient's burden and refer for psychological consultation of rosacea patients.<sup>21</sup> WTP is another well-used health economic method, which can afford complementary information to that revealed by DLQI. WTP is expressed in monetary terms, so it is relatively easier and more intuitive for patients to consider paying certain amounts of money. For those disorders considered to be minor health states, WTP is especially suitable to assess the QoL.<sup>22</sup> As for rosacea, researchers have used DLQI to evaluate HRQoL over the last two decades, and there were a few studies focused on WTP. For specific, Beikert et al used DLQI and WTP to evaluate HRQoL in Germany and found a moderate WTP and mild QoL reduction in patients with rosacea.<sup>23</sup> However, there is lack of research in this area in China so far.

To evaluate the effects of rosacea on the QoL in China, in this study we investigated DLQI and WTP among 921 rosacea patients, and tried to find out the factors associating closely with QoL.

## Materials and Methods

### Study Design

This non-interventional, cross-sectional study was performed among patients with rosacea in Xiangya Hospital of Central South University (Changsha, China) from October 2017 to May 2018. All the patients met the diagnostic criteria based on the National Rosacea Society Expert Committee,<sup>1,24</sup> and were diagnosed independently by two board-certified dermatologists. Patients with other concurrent facial skin diseases such as acne, eczema, seborrheic dermatitis and systemic lupus erythematosus were excluded.

### Questionnaire

In the first part of the questionnaire, sociodemographic and clinical data were recorded. For sociodemographic data, age, gender, income, the occupational requirement of appearance, education, marital status and residential location were collected. In terms of clinical data, the symptoms and signs recorded included flushing, persistent erythema, papules and pustules, angiotelectasis, phymatous changes, plaque, edema, dry sensation, burning sensation, stinging sensation as well as pruritus. For the severity of rosacea, persistent erythema, papules and pustules, angiotelectasis were evaluated by two professional doctors independently and rated as absent, mild, moderate and severe. Patients would be required to report the feeling of flushing, dry sensation, burning sensation, stinging sensation and pruritus rating as 11-point scale (0–10) and ultimately divided into three levels before analysis: absent to mild, moderate and severe.

To measure the HRQoL, Dermatology Life Quality Index (DLQI)<sup>25</sup> and WTP were evaluated. DLQI in Chinese version was used, which contains 10 questions covering six aspects of life including symptoms, feelings, daily activities, leisure time, work or school, personal relationships and treatment. It depends on the patients' perception during the previous week, and total score ranges from 0 to 30. The score can be divided into five classes: 0–1 (no effect), 2–5 (small effect), 6–10 (moderate effect), 10–20 (very large effect), 20–30 (extremely large effect).<sup>26</sup>

To assess WTP, three standard questions were inquired to obtain the amount of money they were willing to pay for a hypothetical drug to control or cure rosacea as previous studies reported.<sup>14,17,23,27</sup> For the disease control question, patients were asked about the amount per month and the percentage of monthly income they were willing to spend. Then, patients were asked to name a total amount of money they would pay at once to achieve the complete cure of rosacea.

## Statistical Analysis

For continuous variables, mean, standard deviation (SD), median and interquartile range (IQR) were described. And for categorical variables, absolute and percentage frequencies were presented. Mann-Whitney *U*-tests and Kruskal-Wallis H-tests were used to compare the independent groups of continuous variables. Statistical correlation analysis was conducted using Spearman's rank test ( $r_s$ ). Multivariate binary and ordinal logistic regression analyses were used to elicit the predictors for DLQI. Multivariate linear regression analysis was applied to assess the association between WTP and income (controlling for age, gender, the occupational requirement of appearance, education, marital status and residential location). The level of significance was two-sided and considered to be significant ( $P < 0.05$ ) or highly significant ( $P < 0.001$ ). All analyses were performed with IBM SPSS version 21 for Windows.

## Results

### Total Subject Population

A total of 973 patients were recruited into our study, 921 questionnaires were collected for analysis of DLQI and 594 participants fulfilled the WTP questionnaire. The sociodemographic and clinical characteristics were displayed in Tables 1 and 2, respectively. The mean  $\pm$  SD age of our study population was  $32.4 \pm 11.1$  years (median 30, IQR 23–41). And females accounted for 91.0% of all patients.

Almost all patients had a flushing manifestation ( $n = 916$ , 99.5%). Of patients with phymatous change, 34.9% (29/83) were male. The mean disease duration was  $4.8 \pm 5.7$  years with those over 2 years accounting for 58.3% (537/921). Almost half of the patients (436/921, 47.3%) had three or more facial regions involved. And 11.6% (107/921) of the participants had a family history.

### DLQI

The mean DLQI total score of the patients was  $11.6 \pm 7.2$  (median 11, IQR 6–16). About half (496/921, 50.9%) of them thought the impact of rosacea on HRQoL was large to extremely large. Especially prominent impairment in HRQoL was observed in the items of “work/school” and “embarrassed or self conscious” in DLQI (Figure 1).

### Sociodemographic Characteristics Associating with DLQI

Statistically significant differences in DLQI score were observed in age, gender, the occupational requirement of appearance (Table 1). Females rated a significantly higher DLQI score ( $P < 0.001$ ). For different age groups, we observed the most severe HRQoL impairment in patients aged 31–40 years, which was significantly different from patients aged 41–50 years ( $P = 0.008$ ) and over 50 years ( $P < 0.001$ ). The occupational requirement of appearance was positively correlated with DLQI ( $r_s = 0.148$ ,  $P < 0.001$ ). Those with high occupational requirements of appearance had significantly higher DLQI score (Table 1) than the other three groups. No significant differences were observed in marital status, residential location and education (Table 1).

### Clinical Characteristics Associating with DLQI

Regarding phymatous changes, patients with phymatous changes exhibited a significantly lower DLQI score (Table 1,  $P = 0.004$ ). Patients with the signs including angiotelectasis ( $P = 0.033$ ), plaque ( $P = 0.021$ ) and edema ( $P < 0.001$ ) rated significantly higher DLQI scores than the corresponding negative counterparts (Table 1). Patients with shorter disease duration tended to have higher DLQI score (Table 1,  $P = 0.001$ ).

We next divided the severity of rosacea into four or three levels as mentioned earlier, flushing, erythema, dry sensation, burning sensation, stinging sensation and pruritus displayed a positive correlation with DLQI level ( $r_s = 0.106$ ,  $P = 0.001$ ;  $r_s = 0.109$ ,  $P = 0.001$ ;  $r_s = 0.120$ ,  $P < 0.001$ ;  $r_s = 0.234$ ,  $P < 0.001$ ;  $r_s = 0.212$ ,  $P < 0.001$ ;  $r_s = 0.199$ ,  $P < 0.001$ ; respectively) (Table 2). Also, patients with different severity of the above symptoms had significantly different DLQI total scores (H-test:  $P < 0.01$ ). Corresponding with the correlation between DLQI score and the severity of flushing, patients with longer daily flushing duration also had higher DLQI scores (Table 2).

**Table 1** DLQI Scores According to Sociodemographic Characteristics and Clinical Characteristics

	<b>N (%)</b>	<b>DLQI Mean ± SD (Median, IQR)</b>	<b>P-value</b>
Age (years)			
≤20	93 (10.1)	9.1 ± 5.8 (9, 4–12)	<0.001
21–30	400 (43.4)	11.8 ± 6.9 (11, 7–16)	
31–40	187 (20.3)	13.6 ± 7.6 (12, 8–19)	
41–50	193 (21.0)	11.1 ± 7.4 (11, 5–16)	
> 50	48 (5.2)	8.0 ± 6.2 (7, 3–11)	
Gender			
Male	83 (9.0)	8.9 ± 5.6 (8, 5–12)	<0.001
Female	838 (91.0)	11.8 ± 7.2 (11, 6–17)	
Marital status			
Married	510 (55.4)	11.9 ± 7.6 (11, 6–17)	0.378
Single	411 (44.6)	11.2 ± 6.5 (10, 6–15)	
Occupational appearance			
No requirement	345 (37.5)	10.2 ± 6.6 (10, 5–14)	<0.001
Not sure	389 (42.2)	12.3 ± 7.5 (11, 6–17)	
Low requirement	159 (17.3)	11.8 ± 6.9 (11, 7–16)	
High requirement	28 (3.0)	17.4 ± 7.5 (17, 12–25)	
Residential location			
Provincial capital	463 (50.3)	11.5 ± 7.2 (10, 10–16)	0.490
Prefecture-level city	274 (29.7)	12.0 ± 7.3 (11, 6–17)	
County or county-level city	184 (20.0)	11.3 ± 7.0 (11, 6–14)	
Education			
≤ Elementary school	53 (5.8)	12.2 ± 7.2 (11, 7–16)	0.587
Secondary school	151 (16.4)	12.4 ± 7.5 (11, 7–18)	
High /technical secondary school	98 (10.6)	11.3 ± 7.0 (11, 5–16)	
Junior college	106 (11.5)	11.7 ± 7.0 (10, 6–17)	
≥ Undergraduate	513 (55.7)	11.3 ± 7.1 (10, 5–15)	
Flushing			
Present	916 (99.5)	11.6 ± 7.1 (11, 6–16)	0.045
Absent	5 (0.5)	6.4 ± 10.0 (2, 0.5–14.5)	
Persistent erythema			
Present	821 (89.1)	11.7 ± 7.2 (11, 6–16)	0.213
Absent	100 (10.9)	10.8 ± 6.8 (10, 5.25–14.75)	
Papules and pustules			
Present	609 (66.1)	11.6 ± 7.1 (11, 6–16)	0.835
Absent	312 (33.9)	11.6 ± 7.3 (10, 6–16)	
Telangiectasia			
Present	515 (55.9)	12.0 ± 7.3 (11, 7–17)	0.033
Absent	406 (44.1)	11.0 ± 7.0 (10, 5–15)	
Phymatous changes			
Present	83 (9)	9.6 ± 7.0 (8, 3–14)	0.004
Absent	838 (91.0)	11.8 ± 7.2 (11, 6–16)	
Plaque			
Present	68 (7.4)	13.5 ± 7.4 (12.5, 8–18.5)	0.021
Absent	853 (92.6)	11.4 ± 7.1 (11, 6–16)	
Edema			
Present	146 (15.9)	14.1 ± 8.1 (13, 8–20)	<0.001
Absent	775 (84.1)	11.1 ± 6.9 (10, 6–15)	

(Continued)

**Table 1** (Continued).

	<b>N (%)</b>	<b>DLQI Mean ± SD (Median, IQR)</b>	<b>P-value</b>
Lesion area (location amount)			
≤ 3	485 (52.7)	11.3 ± 7.3 (10, 5–15)	0.115
≥ 3	436 (47.3)	12.0 ± 7.0 (11, 7–16)	
Disease duration (years)			
< 2	265 (28.8)	13.0 ± 7.6 (12, 7–19)	0.001
≥ 2	537 (58.3)	11.1 ± 6.8 (10, 6–15)	
Unknown	119 (12.9)	10.5 ± 7.2 (10, 5–15)	
Family history			
Yes	107 (11.6)	11.1 ± 6.6 (11, 6–15)	0.473
Absent	783 (85.0)	11.6 ± 7.2 (11, 6–16)	
Unknown	31 (3.4)	13.5 ± 8.4 (11, 8–21)	

**Abbreviations:** DLQI, Dermatology Life Quality Index; SD, standard deviation; IQR, interquartile range.

### Factors Independently Associating with DLQI

In a binary logistic regression model predicting HRQoL reduction, DLQI score was independently related to age, gender, occupational requirement of appearance, disease duration, the presence of edema, the severity of certain symptoms (ie, flushing, burning sensation, stinging sensation and pruritus) (Table 3). With ordinal logistic regression analysis, we observed the same factors independently affected DLQI, with the exclusion of gender (Table 3).

### Willingness to Pay

When participants were asked to name a monthly cost that they were willing to spend for controlling the disease, the average amount was € 106.5 ± 6.7 (median €61.3, IQR €36.8–122.7). Concerning the percentage of monthly income (relative WTP), patients accepted to spend 23.2% ± 0.97% (median 15.5%, IQR 10–30%) on average. 198 out of 594 participants (33.3%) would like to pay more than 20% of their monthly income to achieve sustainable control. As to one-time payment for a complete cure of rosacea, the average amount patients willing to pay was €896.2 ± 68.5 (median €368.1, IQR €0–1227). We observed a negative correlation between relative WTP and age ( $r_s = -0.230$ ,  $P < 0.001$ ). And income was significantly associated with the one-time WTP ( $B = 0.031$ ,  $P < 0.001$ ) and monthly WTP ( $B = 0.005$ ,  $P < 0.001$ ) after adjusting other sociodemographic characteristics.

Additionally, among participants who were willing to invest some money for controlling or completely curing of the disease, we observed positive correlations between DLQI total score and the one-time WTP ( $r_s = 0.130$ ,  $P = 0.01$ ), monthly WTP ( $r_s = 0.139$ ,  $P = 0.001$ ) as well as relative WTP ( $r_s = 0.110$ ,  $P = 0.01$ ). For patients with DLQI total score more than 10, 16.9% (54/319) of them were willing to pay no less than €245.4 monthly, and 19.5% (62/319) of them were willing to pay more than €1227 one-time (DLQI < 10: 7.6% (21/275) and 13.1% (36/275), respectively) (Figure 2). When the participants were divided into two group according to the WTP (one-time WTP: ≤ €2454 and > €2454; monthly WTP: < €122.7 and ≥ €122.7; relative WTP: < 20% and ≥ 20%), the high WTP groups always have significantly higher DLQI score ( $U$ -test: one-time WTP,  $P = 0.001$ ; monthly WTP,  $P < 0.001$ ; relative WTP,  $P = 0.009$ ) than the corresponding low WTP groups (data not shown).

### Discussion

Rosacea is a chronic inflammatory skin disorder mainly affects centofacial areas resulting in physical disfigurement and emotional distress and impairs the patients' quality of life. In this study, we evaluated the effects of rosacea on the QoL by investigating DLQI and WTP among 921 rosacea patients in China, which verified that rosacea could significantly impair QoL. Age, occupational requirement of appearance, disease duration, severity of flushing and the related symptoms were primary factors associated with the QoL. On the other hand, rosacea has been suggested to be considered a systemic disease, which was associated with some other diseases including psychiatric disorders.<sup>28</sup> Rosacea treatment

**Table 2** DLQI Scores According to Adjusted Clinical Characteristics

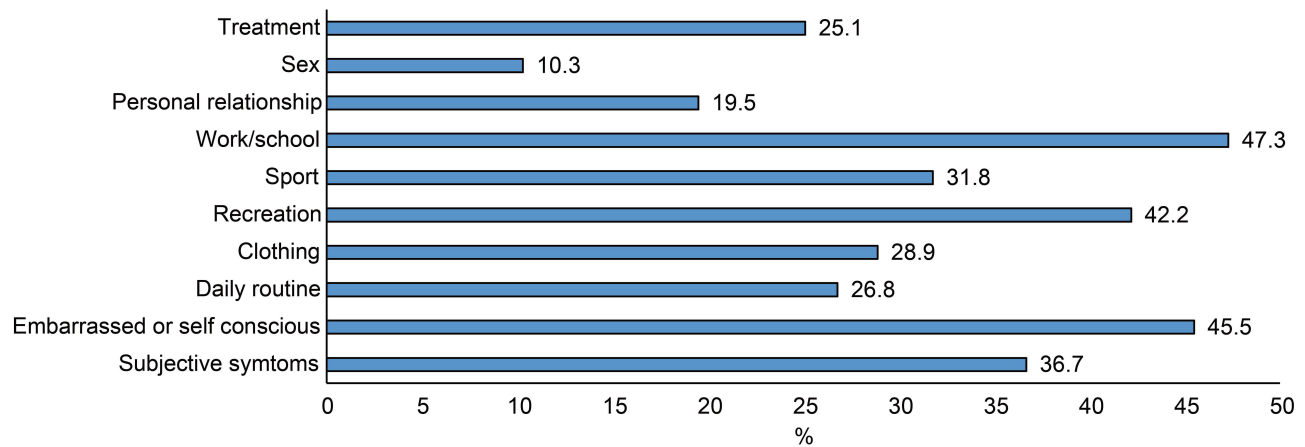
	DLQI Mean $\pm$ SD (Median; IQR)	Odds Ratio	95% CI	P-value
Flushing duration (minutes/per day)				
$\leq$ 30	11.0 $\pm$ 7.1 (10, 5–15)	Ref	Ref	Ref
$>$ 30	12.3 $\pm$ 7.2 (12, 7–17)	1.433	1.118–1.837	0.005
Severity of erythema				
Absent	10.3 $\pm$ 7.5 (7, 5–15)	Ref	Ref	Ref
Mild	10.2 $\pm$ 6.5 (9, 5–13)	1.096	0.501–2.400	0.818
Moderate	11.7 $\pm$ 7.3 (11, 6–16)	1.480	0.699–3.135	0.306
Severe	13.4 $\pm$ 7.2 (13, 8–19)	2.432	1.076–5.499	0.033
Severity of papules and pustules				
Absent	11.4 $\pm$ 7.2 (10, 5.5–16)	Ref	Ref	Ref
Mild	11.9 $\pm$ 7.6 (11, 6–17)	1.117	0.796–1.568	0.521
Moderate	11.0 $\pm$ 6.9 (10, 5–15)	0.972	0.700–1.349	0.864
Severe	12.3 $\pm$ 6.9 (12, 7–17)	1.327	0.898–1.960	0.156
Severity of flushing				
Absent to mild	9.4 $\pm$ 6.6 (8, 5–12)	Ref	Ref	Ref
Moderate	11.8 $\pm$ 7.1 (11, 6–16)	1.844	1.295–2.625	<0.001
Severe	12.2 $\pm$ 7.3 (11, 7–17)	2.108	1.399–3.177	0.001
Severity of dry sensation				
Absent to mild	10.4 $\pm$ 6.7 (9, 5–14)	Ref	Ref	Ref
Moderate	11.7 $\pm$ 7.4 (11, 6–17)	1.280	0.961–1.706	0.092
Severe	12.8 $\pm$ 7.2 (12, 8–18)	1.679	1.262–2.233	<0.001
Severity of burning				
Absent to mild	9.9 $\pm$ 6.4 (9, 5–14)	Ref	Ref	Ref
Moderate	12.3 $\pm$ 7.2 (11, 7–16)	1.908	1.441–2.526	<0.001
Severe	14.2 $\pm$ 7.6 (14, 8–20)	2.779	2.051–3.765	<0.001
Severity of stinging				
Absent to mild	10.2 $\pm$ 6.7 (9, 5–14)	Ref	Ref	Ref
Moderate	12.8 $\pm$ 7.2 (12, 7–18)	1.915	1.490–2.461	<0.001
Severe	17.6 $\pm$ 7.8 (17, 11–25)	5.396	3.090–9.424	<0.001
Severity of pruritus				
Absent to mild	9.9 $\pm$ 6.6 (9, 5–14)	Ref	Ref	Ref
Moderate	12.2 $\pm$ 7.2 (11, 7–17)	1.773	1.382–2.274	<0.001
Severe	15.3 $\pm$ 7.7 (14, 9.5–22)	3.611	2.300–5.668	0.000

**Notes:** Ordinal logistic regression model adjusted by age and gender (DLQI levels: no effect, small effect, moderate effect, very large effect, extremely large effect).

**Abbreviations:** Ref, reference; CI, confidence interval.

remains challenging for dermatologists, so dermatologists should pay attention to patient experience and patient education.<sup>29</sup> QoL can, to some extent, reflect the patient individual experience. Our discovery donates a guide for clinicians to rapidly recognize patients whose QoL were severely impaired, to better manage these patients and improve treatment satisfaction. In turn, QoL can be an indicator to assess the treatment effectiveness.

DLQI is a classic instrument for evaluating HRQoL and widely used in studies regarding disease burden. An authorized DLQI in Chinese version has been widely used in skin diseases for research or clinical settings in China. A study conducted in 851 Chinese patients with psoriasis showed a mean DLQI score of 11.34.<sup>19</sup> As to alopecia areata and androgenetic alopecia, a relative low mean DLQI score of 6.3 was reported,<sup>30</sup> similar results were showed in another study which showed a DLQI score of 7.21 for alopecia areata and 8.30 for androgenetic alopecia.<sup>31</sup> Two studies focused on vitiligo conducted in the Chinese patients obtained the mean overall DLQI scores of 8.41 and 5.83, respectively.<sup>16,32</sup> One study showed Chinese patients with lepromatous leprosy had a mean DLQI score of 18.78.<sup>33</sup> In this study, the mean score of DLQI for rosacea was 11.6, indicating the huge effect of rosacea on patients' HRQoL<sup>26</sup> comparable with that in psoriasis patients,<sup>19</sup> and more severe than patients with other common dermatosis such as vitiligo,<sup>16</sup> alopecia.<sup>30,31</sup>



**Figure 1** Percentage of patients by DLQI items rated moderately or severely affected.

**Abbreviation:** DLQI, Dermatology Life Quality Index.

The DLQI score of rosacea obtained in the current study was in the range reported in a systematic review (4.1–17.3),<sup>34</sup> similar to the results of another study focused on rosacea in China,<sup>35</sup> but much higher than the published data from other countries.<sup>7,23,36</sup> It has been recognized that age is negatively correlated with DLQI score.<sup>34</sup> The mean age of our study population was relatively younger, which may, at least in part, explain our higher DLQI score. On the other hand, all our participants were recruited from the hospital which might lead to a select bias, contributing to their relatively high DLQI score. Based on our study, women were more likely to suffer greater impairment on HRQoL. This finding was consistent with the published researches conducted by Beikert et al<sup>23</sup> and Aksoy et al.<sup>36</sup> One possible reason was that women often paid more attention to their appearance. Concerns about the impaired appearance always cause some emotional problems like embarrassment or low self-esteem,<sup>11</sup> negatively affecting the HRQoL. In addition, occupational requirement of appearance was an independent factor associated with HRQoL, with higher requirement indicating more severe impairment of HRQoL. Accordingly, we observed that “work/school” and “embarrassed or self-conscious” contained in DLQI displayed as the most prominent affected items among rosacea patients. Thus, asking the occupational requirement of appearance is helpful to easily and rapidly assess the impact of rosacea on HRQoL.

As rosacea is a chronic disease, patients with long disease duration may be forced to fit this situation, and the impaired HRQoL may be restored or turn to be tolerable. In the current study, we observed that patients with shorter disease duration had more severe impairment on HRQoL, which is consistent with the results from other studies.<sup>23,37</sup> In the multivariable analysis, we found the severity of flushing and the accompanied subjective feelings (ie, burning, stinging, dry sensation and pruritus) rather than objective signs could independently impact DLQI score, which is consistent with a previous study.<sup>36</sup> In addition to the severity level of flushing, the longer daily duration of flushing was also found to be associated with a higher DLQI score, although this association turned insignificant in multivariate analysis. These results indicate patients with more severe subjective symptoms were more likely to have severe impairment of HRQoL, just as the previous viewpoint mentioned, flushing and burning were the most disturbing symptoms of rosacea.<sup>38</sup> Therefore, we suggest more frequent follow-up visits for patients who complain about severe subjective symptoms.

For other phenotypes of rosacea, we observed a potential association between edema and high DLQI score, which is consistent with a previous study.<sup>7</sup> Interestingly, patients with phymatous changes were related to a significantly low DLQI score, but the trend turned insignificant in a multivariable analysis model.

As for other visible signs including the presence of plaque and severity of persistent erythema, angioedema, papules and pustules, we did not find any significant correlation with the DLQI score. It follows that the sensitive symptoms were associated more closely with the limitation of QoL than the common objective signs of rosacea. However, it has been well-recognized that some patients lacking clinical severe visible signs would complain of

**Table 3** Factors Independently Associating with DLQI Total Score

	Model I <sup>a</sup>			Model II <sup>b</sup>		
	Odds Ratio	CI 95%	P-value	Odds Ratio	CI 95%	P-value
Gender						
Male	Ref	Ref	Ref	Ref	Ref	Ref
Female	2.044	1.085–3.850	0.027	1.529	0.919–2.544	0.102
Age (years)						
≤ 20	2.492	0.791–7.845	0.119	1.792	0.787–4.079	0.165
21–30	4.882	1.703–13.993	0.003	3.242	1.547–6.795	0.002
31–40	5.073	1.724–14.929	0.003	3.617	1.684–7.770	0.001
41–50	3.051	1.040–8.954	0.042	1.836	0.855–3.944	0.119
> 50	Ref	Ref	Ref	Ref	Ref	Ref
Occupational appearance						
No requirement	Ref	Ref	Ref	Ref	Ref	Ref
Not sure	1.944	1.327–2.849	0.001	2.113	1.495–2.988	<0.001
Low requirement	1.495	0.952–2.349	0.081	1.449	0.985–2.131	0.060
High requirement	3.581	1.188–10.796	0.023	4.410	1.892–10.281	0.001
Disease duration						
< 2 years	1.660	1.180–2.336	0.004	1.582	1.190–2.104	0.002
≥ 2 years	Ref	Ref	Ref	Ref	Ref	Ref
Edema						
Present	1.718	1.048–2.817	0.032	1.844	1.224–2.780	0.003
Absent	Ref	Ref	Ref	Ref	Ref	Ref
Severity of flushing						
Absent to mild	Ref	Ref	Ref	Ref	Ref	Ref
Moderate	2.562	1.555–4.220	0.000	2.026	1.329–3.089	0.001
Severe	2.671	1.480–4.819	0.001	2.003	1.195–3.356	0.008
Severity of burning						
Absent to mild	Ref	Ref	Ref	Ref	Ref	Ref
Moderate	1.812	1.247–2.634	0.002	1.734	1.256–2.392	0.001
Severe	2.164	1.415–3.308	0.000	1.981	1.367–2.871	<0.001
Severity of stinging						
Absent to mild	Ref	Ref	Ref	Ref	Ref	Ref
Moderate	1.245	0.878–1.765	0.219	1.368	1.013–1.846	0.041
Severe	2.548	1.031–6.299	0.043	2.491	1.270–4.883	0.008
Severity of pruritus						
Absent to mild	Ref	Ref	Ref	Ref	Ref	Ref
Moderate	1.312	0.932–1.847	0.120	1.485	1.106–1.994	0.009
Severe	2.207	1.048–2.817	0.016	2.249	1.324–3.822	0.003

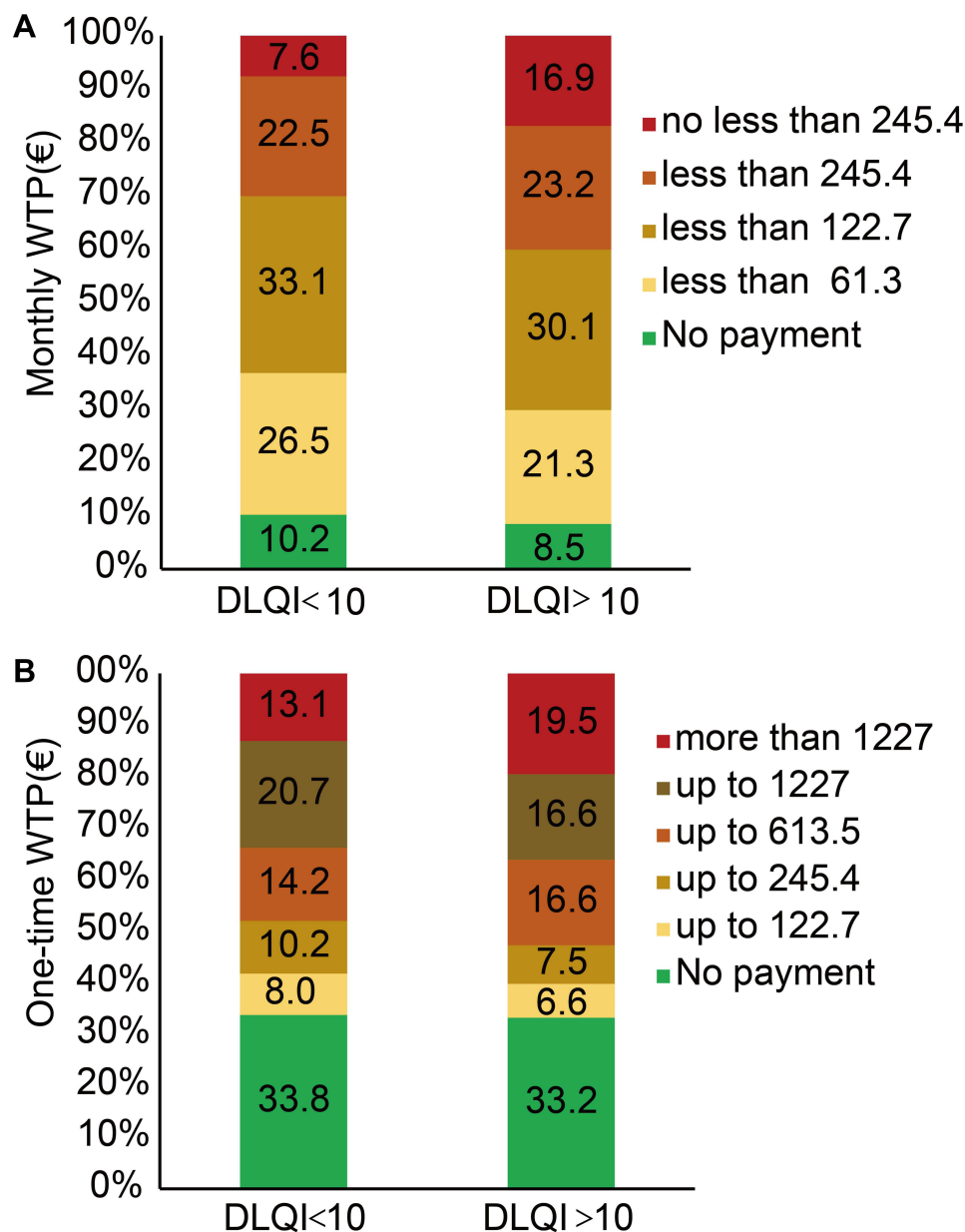
**Notes:** <sup>a</sup>Binary logistic regression model (DLQI ≤ 10 vs DLQI > 10). <sup>b</sup>Ordinal logistic regression model (DLQI levels: no effect, small effect, moderate effect, very large effect, extremely large effect).

**Abbreviations:** Ref, reference; CI, confidence interval.

a great influence on their quality of life.<sup>21</sup> Additionally, a study in acne showed that even if the visible signs of a disease were resolved, it is relatively difficult to improve patients' emotional status.<sup>39</sup> This situation also happens in rosacea patients. For these patients, the “non-visible” QoL limitations were frequently overlooked by the clinicians. This inconsistent view about the disease severity between the clinicians and patients may interfere with the therapeutic decisions and reduce treatment satisfaction. Recognizing those patients with severe impaired HRQoL is thus essential in the clinical process.

WTP is another method estimating HRQoL from the economic perspective, which may be more intuitive than DLQI. WTP was relatively rarely used in dermatosis in China. In the current study, we used the relative WTP which seems to be income-independent to compare our WTP with other diseases and in other countries. In our study, patients accepted to





**Figure 2** Monthly WTP (A) and one-time WTP (B) distribution in DLQI < 10 and > 10. The euro symbol (€) represents the euro currency. **Abbreviations:** DLQI, Dermatology Life Quality Index; WTP, willingness to pay.

spend 15.5% (median) of their monthly income (relative WTP) for long-term treatment. According to relative WTP, patients with rosacea have comparable HRQoL impairment to patients with atopic dermatitis, psoriasis, alopecia areata, and port wine stains,<sup>17,40,41</sup> but less severe impairment than low-risk melanoma.<sup>27</sup> These data indicate a large effect of rosacea on QoL.

Based on our results, about one-third (33.3%) of the individuals were willing to pay a relative WTP more than 20%, with the proportion a little higher than the data reported in Germany (11.4%).<sup>23</sup> That may be attributed to a relatively young participant, as in our study age seemed to have a negative correlation to the relative WTP. In addition, we observed a positive correlation between DLQI and WTP. This correlation has been proposed in previous studies about rosacea and other dermatological diseases.<sup>15,17,23,42</sup> Unexpectedly, we did not observe any significant associations between WTP and most of the clinical factors including the presence or severity of symptoms and signs, the disease duration, lesion area, as well as family history (data not shown). The possible reason may be explained by the selection bias, as one-third of the

participants refused to provide the WTP data. Nevertheless, the good correlations between WTP and DLQI provide the evidence of WTP as a screen indicator for individuals with poor QoL in Chinese rosacea patients.

There may be some limitations in our study. First, the mean age of the study population was relatively young, compared to similar studies in other countries. Additionally, as we mentioned above, the participants included in our study all came from the hospital affiliated to a university, so they might have either more severe rosacea or greater QoL impairment. The consequences of these biases may cause QoL impairment overrated.

In summary, in this study we confirm that rosacea exerts a substantial burden on patients' life with severe limitations of HRQoL and high values of WTP. There were positive correlations between WTP and DLQI. Patients aged 21–40 years, with high occupational requirement of appearance, with shorter disease duration and severe symptoms tended to have a high possibility of greatly impaired QoL. When admitting these patients, clinicians should attach high importance, HRQoL assessment and psychological counseling are particularly needed.

## Abbreviations

DLQI, Dermatology Life Quality Index; HRQoL, health-related quality of life; OR, odds ratio; QoL, quality of life; WTP, willingness to pay.

## Ethics Approval and Informed Consent

The research was approved by the ethics review board of Xiangya Hospital Central South University. After having been instructed with this study and granted written informed consent, patients were enrolled. The study has been performed in accordance with the Declaration of Helsinki.

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## Disclosure

The authors report no conflicts of interest in this work.

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