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Health-Related Quality of Life and Its Associated Predictors in Patients with Oral Lichen Planus: A Cross-Sectional Study

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ABSTRACT

Objectives: To investigate levels of quality of life (QoL) and determine associated predictors in patients with oral lichen planus (OLP).

Materials and methods: A total of 300 patients with OLP at one tertiary Oral Medicine clinic in the UK were recruited in a cross-sectional study from January 2018 to July 2019. The 15-item Chronic Oral Mucosal Disease Questionnaire (COMDQ-15) and 14-item Oral Health Impact Profile (OHIP-14) were used to assess the level of QoL related to OLP. A number of potential determinants were considered, including patient demographics, treatment, the severity of oral symptoms, the clinical activity of the disease, and the patient psychological status, which were measured using the pain-Numerical Rating Scale, the Oral Disease Severity Score, the Hospital Anxiety and Depression Scale, and the 10-item Perceived Stress Scale. Multivariate linear regression was employed to identify independent determinants associated with overall and aspects of QoL.

Results: On multivariate analyses, after adjusting for confounding variables, the QoL levels in patients with OLP were significantly associated with levels of oral pain, anxiety, stress and use of topical corticosteroids. The COMDQ-15 instrument performed better than OHIP-14 at capturing the association between QoL and pain and disease activity in patients with OLP.

Conclusion: Clinicians should expect reduced QoL in OLP patients with high pain levels, high anxiety levels, high perceived stress and use of topical corticosteroids. The COMDQ-15 is best suited to measure QoL in this population.

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Introduction

Oral lichen planus (OLP) is a common chronic immune-mediated condition causing persistent inflammation and ulceration of the oral mucosa[1]. A recent meta-analysis calculated a global pooled prevalence of OLP of 1.01% with significant geographical differences[2]. The disease is characterised by a spectrum of disease activity from asymptomatic white lesions (reticular, papular, plaque-like) to painful erythematous and erosive/ulcerative lesions[3]. OLP is also associated with a small increased risk of oral cancer development[4]. As the disease currently has no known curative treatment, the primary management goal is to relieve painful symptoms and maintain adequate quality of life (QoL) level of affected individuals[5].

In recent years 'QoL' has increasingly become an important outcome for monitoring the impact of the disease and determining treatment success from the perspective of patients with chronic diseases[6]. Based upon previous qualitative research, the burden of the OLP on a patient's QoL has been associated with both physical impacts of the disease, including oral discomfort and resulting impairment of eating, oral hygiene care and speech, as well as negative

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psychosocial consequences of the disease due to its chronicity, unpredictable clinical behaviour and potentially malignant nature[7]. Despite the significant impact of the disease upon different aspects of patient's QoL, only a small proportion of previous clinical research of OLP incorporates QoL as study outcome.

Evidence suggested that the patients with OLP, particularly those with erythematous/ulcerative types, had a lower QoL than individuals without OLP[8,9]. Previous clinical studies of QoL in OLP mostly utilised generic measures of oral health-related QoL, such as the Oral Health Impact Profile-14 (OHIP-14), which had been developed for use in the general population and appeared to be less sensitive to detect small changes (but clinically important differences) associated with certain conditions including OLP[10]. It is considered appropriate to complement the results from non-specific QoL scales with QoL assessments obtained from instruments containing items with OLP-specific perspectives. Since the early 2010s, several QoL instruments specific to OLP have been developed, and they comprise health aspects that are most important to OLP patients and pertinent to the disease. These instruments include the Chronic Oral Mucosal Disease Questionnaire (COMDQ) and its shortened 15-item version (COMDQ-15), and the Oral Potentially Malignant Disorder Quality of Life (OPMD-QoL) questionnaire[11–13].

Despite rigorous development and the robust psychometric evidence supporting their use, adoption of these OLP-specific QoL instruments in clinical studies has been scarce[14–16], therefore limiting current knowledge of self-reported aspects of QoL unique to the OLP population and hampering their pragmatic application into clinical practice. Given the heterogeneous nature of OLP, each affected patient may experience different disease course and severity. While clinician-rated disease activity based upon clinical oral presentation is of importance in the management of OLP, it might not be perfectly correlated with how patients perceive and function. Information on the QoL perceived by patients with OLP could be a complementary resource to help prioritise treatment decisions, and the use of data from OLP-specific QoL instruments may provide a more complete approach to the management of OLP. Understanding key determinants of worse QoL in patients with OLP is also a prerequisite for the development of effective strategies for early identification of patients at risk and ultimately for improving the quality of care for patients.

The primary objective of the present study was thus to examine levels of overall and aspects of QoL in a cohort of patients with OLP using both an OLP-specific QoL instrument (COMDQ-15) and non-specific oral health-related QoL instrument (OHIP-14). In addition, independent predictors of worse QoL were investigated. The predefined hypotheses were as follows: demographic factors (i.e. older age, female, Asian and Black ethnicity, current smoker, alcohol use of at least 14 units/week, having at least two disease co-morbidities); psychological factors (i.e. higher levels of symptoms of anxiety, depression, distress and perceived stress); and clinical variables (i.e. ulcerative (presence of erosive or ulcerative/ulcerative type of OLP, greater disease severity, higher level of oral pain, presence of extraoral lichen planus, and the use of topical and systemic treatment) were associated with poorer level of QoL in patients with OLP.

Materials and methods

Study design

This was a descriptive secondary analysis of baseline data from the Determination of Minimal Important Difference and Patient Acceptable Symptom State of Patient-Reported Outcome Measures in Immunologically Mediated Oral Mucosal Diseases (MEAN-IT) study, which received a favourable opinion from the London – Queen Square Research Ethics Committee (REC reference 17/LO/1825; approval date 3 November 2017).

Participants

The study participants comprised 300 patients with OLP attending the Oral Medicine clinic, UCLH Eastman Dental Hospital, London, UK for regular review appointments. Participant recruitment was based upon convenience sampling. All potentially eligible participants, in all Consultant-lead Oral Medicine clinics from January 2018 to July 2019 were invited to participate.

The inclusion criteria were patients with clinical and histopathologically confirmed OLP based upon modified WHO diagnostic criteria[17]. The exclusion criteria were as follows: (i) evidence of oral epithelial dysplasia in the biopsy specimen; (ii) evidence of proven hypersensitivity to dental restorative materials; (iii) evidence of oral lichenoid lesions associated with graft-versus-host disease and systemic lupus erythematosus; (iv) coexisting chronic neuropathic orofacial pain such as burning mouth syndrome, persistent idiopathic facial pain and trigeminal neuropathic pain; (v) patient-reported significant underlying systemic conditions (ASA 3 or more) and/or some psychiatric illnesses as defined by DSM-5, which might interfere with study participation such as Parkinson's disease, Alzheimer's disease and schizophrenia; and (vi) inability to read English language and understand questionnaires.

Procedure

A comprehensive oral examination was performed on all study participants to assess oral sites of involvement and disease activity using the Oral Disease Severity Score (ODSS). Participants were categorised into three groups on the basis of the clinical variant of OLP: (i) keratotic (presence of white reticular, papular or plaque-like lesions without apparent erythema/ulceration); (ii) erythematous (presence of atrophic/erythematous lesions with/without reticular/popular/plaque-like features AND no evidence of erosion/ulceration); and (iii) erosive/ulcerative (presence of erosive or ulcerative lesions with/without the presence of keratotic and/or erythematous changes of OLP).

Participants were then asked to complete a demographic form and a set of patient-reported questionnaires associated with oral symptoms, psychological status (level of anxiety, depression, distress and perceived stress) and patient's perception of QoL relevant to their OLP over the past month. Information regarding medical history, social history and past OLP-related history including disease duration, extraoral involvement of lichen planus (either patient-reported or

confirmed by a dermatologist), and management was obtained from electronic patient records.

Outcomes

The primary outcome of the present study was the QoL in patients with OLP as indicated by total and subscale scores of the as indicated by total and subscale scores of the COMDQ-15 and the OHIP-14. To determine associated predictors of QoL in patients with OLP, selected demographic characteristics, psychological and OLP-related factors were assessed. Demographic characteristics included age (continuous variable), gender (female/male), ethnicity (White/Mixed/Asian/Black), smoking status (non-smoker/ex-smoker/current smoker), alcohol use (no/up to 14 units/more than 14 units per week) and disease co-morbidities (no/one/at least two disease co-morbidities).

Regarding psychological factors, the Hospital Anxiety and Depression Scale (HADS) was used to measure level of anxiety, depression and distress, while level of perceived stress was evaluated by the 10-item Perceived Stress Scale (PSS-10). OLP-related factors included disease duration [time since symptom onset of OLP (years)], clinical types (keratotic/erythematous/erosive-ulcerative), level of disease activity using the validated ODSS (site score/activity score/total score), level of oral pain using the 0–10 pain-Numerical Rating Scale (NRS), presence of self-reported extraoral lichen planus (LP) (no/yes-genital area/yes-skin) and treatment (no treatment or topical anaesthetic agents only/topical corticosteroids only/topical corticosteroids and other topical treatment/topical and systemic treatment).

Outcome measures

Measures of quality of life

The COMDQ-15 is a recently developed brief version of the original 26-item COMDQ, which measured QoL specific to patients suffering from chronic oral mucosal conditions including OLP[13]. This 0–4 Likert-type scale evaluates four QoL domains, including the 'physical discomfort' (PD, 5 items), 'medication and treatment' (MT, 3 items), 'social and emotional' (SE, 5 items), and 'patient support' (PS, 2 items). Total COMDQ-15 score are calculated by summation of the responses of all items, giving the possible maximum score of 60. The COMDQ-15 has good evidence supporting its validity, reliability and responsiveness for use in patients with OLP[13,18].

The OHIP-14 is a 14-item, 5-point (0–4) Likert-type questionnaire assessing general oral health-related QoL on seven domains (each with two items) including functional limitation (FL), physical pain (PhyP), psychological discomfort (PsyD), physical disability (PhyDis), psychological disability (PsyDis), social disability (SD) and handicap (H). The maximum possible subscale and total score of this scale are 8 and 56, respectively. The greater the OHIP-14 score the poorer the patient's perception is of their general oral health-related QoL[19].

Measures of psychological factors

The HADS is a 14-item, 0–3 Likert-type scale with seven questions (HADS-A) dedicated to the assessment of anxiety symptoms, and the other seven (HADS-D) to the assessment of depressive symptoms. Subscale scores of the HADS of eight or over are indicative of the presence of anxiety or depressive symptoms, and the total score (HADS-T) from the sum scores of HADS-A and HADS-D of 15 or over indicate the presence of psychological distress[20,21].

The PSS-10 is a 10-item, 0–4 Likert-type scale that examined participants' level of perceived stress over the past month. Four items of the PSS-10 (items 4, 5, 7, 8) are positively stated items and require reverse coding. Total PSS-10 score was obtained by the summation of all the item scores, providing a total score range of 0–40. A higher score represents greater perceived stress. Based upon total PSS-10 scores, scores of 0–13, 14–26 and 27–40 are considered mild, moderate and high level of perceived stress, respectively[22]. Both the HADS and PSS-10 were found to have acceptable validity and reliability for use in patients with OLP[23].

Measure of oral pain

The NRS for pain estimated severity of oral pain currently (e.g. at the time of the study visits) experienced by a patient on a whole number scale of 0–10 (11-point scale)[24]. The NRS was validated for use in the OLP population with psychometric evidence supporting its psychometric adequacy[25].

Measure of disease activity

The ODSS is a validated clinical scoring for the measurement of the severity of oral mucosal conditions including OLP[26]. The ODSS assesses the presence, extent and severity of mucosal lesions in 17 oral subsites. A total score is the summation of clinician-assessed site and activity scores together with a 0–10 verbal rating scale for average oral pain over the last 2 weeks (this was measured only for the calculation of total ODSS score and not used as pain parameter in the study). The theoretical combined ODSS scores range from 0 to 106. Clinical sensitivity and inter-rater reliability were found to be psychometrically sound for use in patients with OLP.

Data analysis

Statistical analyses were undertaken using STATA version 15.1 (StataCorp, College Station, TX, USA). Participants with missing data were excluded from further analysis. Data distribution of scores of QoL outcomes (the COMDQ-15 and OHIP-14) and other patient-reported outcomes were first checked by the Kolmogorov–Smirnov test. As all the data were nonnormally distributed, descriptive cross-sectional analyses were summarised using median and interquartile range (IQR) for continuous variables, while frequencies and percentages were expressed for categorical variables. To identify potential determinants of QoL, univariate analyses were performed using non-parametric Mann–Whitney *U-test* or Kruskal–Wallis tests with *post hoc* Dunn's Bonferroni adjustment for categorical variables, while spearman rho correlation coefficients were calculated for continuous variables.

Then the association between each significant variable from previous univariate analyses and worse QoL, when adjusted for demographic variables and all significant covariates, was investigated using multivariate linear regression. Each domain and total COMDQ-15 and OHIP-14 scores served as dependent variables for the models. All possible

independent variables with a P-value of < 0.1 from previous univariate analyses were entered together into the models. The assumptions of linear regression (non-collinearity, linearity, homoscedasticity, normality and independence) were confirmed for all models. Model goodness-of-fit was assessed using the adjusted R^2, representing the amount of variance in the dependent variable explained by the independent variables, correcting for the number of predictors in the model. Bonferroni's correction was performed to control inflation of type I error rate due to multiple testing, with adjusted P-value of 0.003 (0.05/number of tests per dependent variable = 0.05/19).

Results

Of a final sample of 300 participants, there were no missing data, and therefore all participants were included in the analysis.

Descriptive characteristics of study participants

The main descriptive demographic and clinical characteristics of the 300 study participants are summarised in Table 1. The mean age of all participants was 63.2 ± 11.5 years (range: 27–88 years), with more females (78%) than males. The median time since symptom onset of OLP was 6.3 years (IQR = 2.7–10.5 years). Erythematous OLP was the most common clinical variant in this patient cohort (67%), followed by keratotic and erosive/ulcerative OLP (14.7%). About one-quarter of participants had at least one site of extraoral involvement, and genitalia (15.7%) and skin (12.7%) were the two most common sites of extraoral involvement of LP in this sample. The vast majority of patients (83%) reported having at least one disease co-morbidity, and the most frequent systemic conditions were hypertension (33%), hypercholesterolaemia (18.7%), osteoarthritis (14%), diabetes mellitus (12.7%) and hypothyroidism (12.3%).

Quality of life outcomes in patients with oral lichen planus

Bivariate analysis of demographics and OLP-related variables by QoL scores based upon the COMDQ-15 and OHIP-14 are present in Tables 1 and 2, respectively. Overall, the results of total scores of both QoL scales were similar. Among patients with OLP in the present cohort, Asian ethnicity was found to have significantly worse QoL than white ethnicity, while those who drank alcohol more than the recommended alcohol limit (> 14 units/week) appeared to report better QoL level than alcohol abstainers. Regarding clinical types of OLP, patients with erosive/ulcerative OLP had significantly poorer overall QoL than those with keratotic OLP. While patients with erythematous OLP reported poorer QoL than those with keratotic OLP, the difference between the two groups did not reach the Bonferroni-corrected significance level (P = 0.003). Regarding treatment types, those who received topical steroids with other treatments appeared to report worse QoL than those who did not receive any treatment or receive only topical anaesthetic agents.

Regarding correlation studies between QoL and other variables, it was observed that total scores of both QoL scales were positively and significantly associated with scores of the pain-NRS, HADS-anxiety, HADS-depression, total HADS (distress), PSS-10 (perceived stress), and total, site and activity scores of the ODSS (disease activity) in patients with OLP (P-values < 0.001 in all associations). As for the strength of association, the total COMDQ-15 had slightly stronger association with level of oral pain, perceived stress and total disease activity scores based upon Spearman rho coefficients in patients with OLP when compared with the total OHIP-14. On the contrary, the total OHIP-14 showed greater magnitude of association with level of anxiety, depression and distress than total COMDQ-15 in this OLP cohort.

Determinants of oral lichen planus-specific quality of life based upon the COMDQ-15 scores in patients with oral lichen planus

Based upon the bivariate analysis results (Table 1), the following variables ($P < 0.1$) were identified as potential determinants of worse QoL based upon total COMDQ-15 scores in patients with OLP: Asian ethnicity, alcohol abstainers, ulcerative OLP type, receiving active treatment of OLP (topical corticosteroids with/without other treatment), higher HADS-A scores, higher HADS-D scores, higher HADS-T scores, higher PSS-10 scores, greater pain-NRS, greater disease activity (ODSS-total, -site, -activity) scores, presence of self-reported skin LP. The total HADS, total ODSS, ODSS-site score were not included in the final multivariate model due to collinearity with other variables.

After adjusting for potential confounders, greater level of pain intensity ($\beta = 0.36$, $P < 0.001$), the use of topical corticosteroids combination with other topical treatment ($\beta = 0.24$, $P < 0.001$), topical corticosteroids alone ($\beta = 0.24$, $P < 0.001$) and higher level of perceived stress ($\beta = 0.22$, $P < 0.001$) were retained as independent determinants of overall health-related QoL as measured by total COMDQ-15 scores based upon Bonferroni-corrected significance threshold (P = 0.003). This multivariate model explained about 60% of total variance in the total COMDQ-15 scores. Further details about the independent determinants of subscale COMDQ-15 scores are present in Table 3.

Determinants of general oral health-related quality of life based upon the OHIP-14 scores in patients with oral lichen planus

From the bivariate analysis results (Table 2), covariates with $P < 0.1$ [increased age, female, Asian ethnicity, non-drinkers, having at least two disease comorbidities, ulcerative OLP, presence of self-reported skin and genital LP, receiving active treatment of OLP, higher HADS-A scores, higher HADS-D scores, higher HADS-T scores, higher PSS-10 scores, greater pain-NRS and greater disease activity (ODSS-total, -site, -activity) scores] were included in the multivariate linear regression model for worse QoL based upon the OHIP-14 scores. The total HADS, total ODSS, ODSS-site score, although being significant at bivariate analysis, were excluded in the final model due to collinearity with other variables.

The final multivariate model showed that greater oral pain ($\beta = 0.32$, $P < 0.001$), higher level of anxiety symptoms ($\beta = 0.23$,

Table 1 – Descriptive statistics of variables of study participants and bivariate analysis of factors associated with subscale and total scores of the COMDQ-15 in patients with OLP (N = 300)

Study variables	N (%)	PD		MT		SE		PS		Total score	
		Med (IQR)	P	Med (IQR)	P	Med (IQR)	P	Med (IQR)	P	Med (IQR)	P
Gender†											
Female	234 (78)	10 (6, 14)	0.064	4 (1, 6)	0.58	6 (3, 10)	0.305	2 (1, 4)	0.468	22 (15, 32)	0.125
Male	66 (22)	9 (4, 12)		3 (1, 6)		5 (2, 10)		2 (0, 4)		19 (11, 31)	
Ethnicity†											
White¶	204 (68)	9 (5.5, 13)	0.03	3 (1, 5)	0.000*	5 (2, 8)	0.000*	2 (0, 4)	0.165	19 (13, 28.5)	0.000*
Mixed	6 (2)	6.5 (3, 15)		2.5 (1, 8)		7.5 (1, 13)		1.5 (1, 3)		19 (5, 40)	
Asian	79 (26.33)	11 (8, 15)	¶	5 (3, 8)	¶,*	9 (5, 15)	¶,*	2 (1, 4)		29 (19, 40)	¶,*
Black	11 (3.67)	10 (4, 15)		6 (4, 7)		12 (3, 15)		3 (2, 4)			
Smoking‡										30 (17, 37)	
Non-smoker	228 (76)	9 (6, 13)	0.507	4 (1, 6)	0.626	5.5 (3, 10)	0.687	2 (1, 4)	0.743	21 (13, 32)	0.95
Ex-smoker	59 (19.67)	9 (6, 14)		4 (1, 5)		6 (3, 10)		3 (0, 4)		21 (15, 30)	
Current smoker	13 (4.33)	13 (5, 17)		4 (1, 7)		5 (1, 12)		2 (1, 2)		23 (13, 37)	
Alcohol‡											
No¶	104 (34.67)	10 (7, 15)	0.058	4 (2, 7)	0.002*	8 (3.5, 13)	0.002*	2 (1, 4)	0.45	24.5 (15, 36.5)	0.002*
≤ 14 units/week††	173 (57.67)	9 (6, 13)		4 (1, 6)		5 (3, 10)	¶	2 (0, 4)		21 (13, 30)	
> 14 units/week	23 (7.67)	7 (5, 12)		1 (1, 3)	¶,*,††	3 (2, 6)	¶,*	1 (1, 3)		17 (9, 21)	¶,*
Co-morbidity‡:											
No¶	71 (17)	8 (4, 12)	0.004	3 (1, 6)	0.19	4 (2, 8)	0.015	2 (0, 4)	0.961	17 (13, 25)	0.007
1 co-morbidity††	72 (24)	8 (5, 13)		3.5 (1, 6)		5 (3, 9.5)		2 (1, 4)		21 (13, 28)	
≥ 2 co-morbidities	177 (59)	10 (7, 15)	¶	4 (2, 7)		7 (3, 12)	¶	2 (1, 4)		24 (15, 35)	¶
Clinical types‡											
Keratotic¶	51 (18.33)	7 (3, 13)	0.001*	2 (0, 5)	0.013	5 (2, 8)	0.041	2 (1, 4)	0.437	18 (11, 27)	0.004
Erythematous††	201 (67)	10 (6, 13)	¶	4 (1, 6)		5 (3, 10)		2 (0, 4)		21 (14, 31)	
Erosive/ulcerative	44 (14.67)	12 (9, 15)	¶,*	5 (3, 7)	¶	8 (4.5, 12)	¶	2 (1, 5)		28 (20.5, 35)	¶,*,††
Extraoral LP†											
No	226 (75.33)	9 (5, 13)		3 (1, 6)		6 (3, 10)		2 (1, 4)		20 (13, 31)	
Yes/genital	47 (15.67)	10 (7, 15)	0.092	4 (1, 6)	0.618	7 (3, 13)	0.194	2 (0, 4)	0.102	25 (14, 36)	0.285
Yes/skin	38 (12.67)	12 (7, 15)	0.029	5 (2, 8)	0.009	7.5 (4, 15)	0.047	3 (1, 5)	0.05	29 (17, 41)	0.006
Treatment‡											
No/only Tanes¶	47 (15.67)	3 (2, 8)	0.000*	0 (0, 3)	0.000*	2 (1, 6)	0.000*	1 (0, 4)	0.1	9 (5, 17)	0.000*
TCS alone††	178 (59.33)	10 (6, 13)	¶,*	4 (2, 6)	¶,*	6 (3, 10)	¶,*	2 (1, 4)		22 (15, 31)	¶,*
TCS + other TTx	65 (21.67)	13 (9, 16)	¶,*,††	5 (3, 6)	¶,*	8 (5, 13)	¶,*,††	2 (1, 4)		29 (20, 37)	¶,*,††
TTx + STx	10 (3.33)	10.5 (6, 15)	¶	5 (1, 8)	¶,*	8 (5, 13)	¶	2.5 (1, 5)		25 (18, 44)	¶,*
Age (years)§	65.5 (55.2, 71)	0.004	0.945	-0.094	0.103	−0.093	0.107	−0.168	0.003	−0.087	0.136
Disease duration (years)§	6.3 (2.7, 10.5)	0.049	0.394	0.061	0.295	−0.031	0.599	−0.005	0.931	0.027	0.646
NRS for pain§	3 (1, 5)	0.649	0.000*	0.503	0.000*	0.533	0.000*	0.219	0.000*	0.647	0.000*
HADS-Anxiety§	6 (3, 9)	0.348	0.000*	0.301	0.000*	0.531	0.000*	0.207	0.000*	0.457	0.000*
HADS-Depression§	4 (1, 6)	0.387	0.000*	0.372	0.000*	0.5	0.000*	0.23	0.000*	0.497	0.000*
HADS-total (Distress)§	10 (5, 15)	0.398	0.000*	0.352	0.000*	0.564	0.000*	0.241	0.000*	0.517	0.000*
PSS-10 (Perceived stress)§	16 (11, 21)	0.406	0.000*	0.337	0.000*	0.54	0.000*	0.237	0.000*	0.513	0.000*

(*continued on next page*)

Table 1 (*Continued*)

Study variables	*N* (%)	PD		MT		SE		PS		Total score	
		Med (IQR)	*P*	Med (IQR)	*P*	Med (IQR)	*P*	Med (IQR)	*P*	Med (IQR)	*P*
ODSS total (disease severity)[§]	15 (8, 24)	0.559	0.000*	0.423	0.000*	0.403	0.000*	0.194	0.000*	0.53	0.000*
ODSS-site[§]	6 (3, 8)	0.395	0.000*	0.307	0.000*	0.282	0.000*	0.142	0.014	0.382	0.000*
ODSS-activity[§]	6 (2, 10)	0.47	0.000*	0.338	0.000*	0.319	0.000*	0.184	0.000*	0.436	0.000*
All subjects	300 (100)	9 (6, 14)	–	4 (1, 6)	–	6 (3, 10)	–	2 (1, 4)	–	21 (14, 32)	–

Bold value = *P*-value < 0.05.

STx, systemic treatment; Tanes, topical anaesthetic agents; TCS, topical corticosteroids; TTx, topical treatment.

† Mann—Whitney U-test.

‡ Kruskal—Wallis test.

§ Spearman's rho correlation coefficients.

¶ Significant difference with the first reference group.

‡‡ Significant difference with the second reference group.

* Statistical significance at Bonferroni-corrected *P*-value of 0.003.

$P < 0.001$) and the use of topical corticosteroids combination with other topical treatment ($\beta = 0.019$, $P < 0.001$) remained to be independent predictors of worse general oral health-related QoL based upon total OHIP-14 scores after adjusting for other demographic and OLP-related parameters. This final model explained about 56% of the variance in total OHIP-14 scores. Summary of independent determinants of subscale scores of the OHIP-14 is outlined in Table 4.

Discussion

The present study provides a comprehensive evaluation of QoL, and assesses the ability of various demographic, clinical and psychological outcomes to predict QoL outcomes in a sample of patients with OLP. Assessment of QoL outcomes in patients with OLP could incorporate the patients' perspective to better understand how OLP and its related treatment could impact the entirety of a patient's life, and QoL data could be an important resource to facilitate shared clinical decision-making between clinicians and patients.

The present cross-sectional analysis supported findings from previous studies that patients with ulcerative OLP experienced greater impact of OLP on their QoL than those with other clinical variants[8,27]. Based upon further COMDQ-15 item analysis, it was observed that patients with ulcerative OLP reported a significantly greater level of oral discomfort when eating certain food textures/types and performing oral hygiene care, greater concerns about medication use as well as greater psychosocial burden of OLP. In comparison, although patients with keratotic OLP reported low level of oral pain (median pain-NRS = 1), this patient group still experienced moderate levels of oral discomfort when having certain food types as reflected by the median scores of 2 in PF1 item of the COMDQ-15. This finding is in accordance with a previous study, which found dietary alteration and avoidance in patients with OLP regardless of the presence of erosive/ulcerative lesions[28]. Thus, it is evident that regardless of clinical types, the presence of OLP can have a negative impact on patients' oral activities, and the use of global summary of oral symptoms such as the pain-NRS alone might not be a true reflection of the impact of oral symptoms on patients' everyday living.

Previous studies have attempted to explain factors associated with reduced QoL in patients with OLP, although the findings were inconsistent and difficult to pool due to the use of different QoL measures and study methodology[27,29]. In the present study, after adjustment for potential confounders, independent determinants of overall worse QoL in patients with OLP include greater level of oral pain, the use of topical corticosteroids, higher level of perceived stress and anxiety symptoms. Among these, the most prominent predictor for worse QoL based upon both the COMDQ-15 and OHIP-14 in patients with OLP was greater level of oral pain. Painful oral symptoms are likely to be the most important reason for patients with symptomatic OLP to seek professional treatment[3]. In light of this, effective pain management in this patient population is imperative. One recent study found that OLP patients who had co-morbid psychological distress, including anxiety and depression, appeared to perceive

Table 2 – Bivariate analysis of factors associated with subscale and total scores of the OHIP-14 in patients with OLP (N = 300)

Study variables	FL		PhyP		PsyD		PhyDis		PsyDis		SD		H		Total score	
	Med (IQR)	P	Med (IQR)	P	Med (IQR)	P	Med (IQR)	P	Med (IQR)	P	Med (IQR)	P	Med (IQR)	P	Med (IQR)	P value
Gender†																
Female	2 (0, 3)	0.224	4 (3, 6)	0.328	2 (1, 4)	0.057	3 (1, 5)	0.331	2 (0, 4)	0.042	1 (0, 3)	0.16	1 (0, 3)	0.166	15 (8, 26)	0.085
Male	1 (0, 3)		4 (3, 6)		2 (0, 4)		2 (0, 4)		1 (0, 3)		1 (0, 2)		1 (0, 2)		11 (5, 21)	
Ethnicity†																
White¶	1 (0, 3)	0.014	4 (3, 6)	0.007	2 (1, 4)	0.177	2 (0, 4)	0.000*	1 (0, 3)	0.002*	1 (0, 3)	0.24	1 (0, 2)	0.016	13 (7, 22)	0.001*
Mixed	1 (0, 2)		4 (3, 6)		2 (0, 4)		1 (0, 4)		2 (0, 3)		1 (0, 2)		1 (0, 2)		12 (4, 23)	
Asian	2 (0, 4)	¶	5 (4, 7)	¶,*	3 (1, 6)		4 (2, 6)	¶,*	2 (1, 5)	¶	1 (0, 4)		2 (0, 4)	¶,*	20 (11, 33)	¶,*
Black	3 (1, 5)		6 (3, 7)		2 (1, 8)		5 (2, 8)		3 (2, 7)	¶	2 (0, 2)		1 (0, 3)		26 (10, 39)	
Smoking‡																
Non-smoker	1 (0, 3)	0.291	4 (3, 6)	0.724	2 (1, 4)	0.276	2 (0, 4)	0.672	2 (0. 3)	0.271	1 (0, 3)	0.352	1 (0, 2)	0.474	15 (7, 25)	0.451
Ex-smoker	2 (0, 3)		4 (3, 6)		2(1, 5)		3 (1, 5)		2 (0, 4)		1 (0, 3)		1 (0, 2)		15 (9, 27)	
Current smoker	2 (0, 4)		4 (4, 7)		4 (0, 7)		3 (1, 6)		3 (1, 6)		2 (0, 5)		2 (0, 6)		19 (5, 43)	
Alcohol‡																
No¶	2 (0, 4)	0.008	5 (4, 6)	0.042	3 (1, 5)	0.195	4 (2, 6)	0.000*	2 (0, 4)	0.028	1 (0, 4)	0.014	1 (0, 3)	0.269	19 (9, 33)	0.007
≤ 14 units/week	1 (0, 3)		4 (3, 6)		2 (1, 4)		2 (0, 4)		2 (0, 3)		1 (0, 3)		1 (0, 2)		14 (8, 23)	¶
> 14 units/week	1 (0, 2)	¶	4 (2, 5)		3 (0, 4)		1 (0, 3)	¶,*	1 (0, 2)	¶	0 (0, 1)	¶	1 (0, 2)		12 (5, 18)	¶,*
Co-morbidity†																
No¶	(0, 2)	0.013	4 (2, 5)	0.01	2 (1, 4)	0.42	2 (0, 4)	0.044	2 (0, 3)	0.03	1 (0, 3)	0.496	1 (0, 2)	0.026	13 (5, 21)	0.03
1 co-morbidity††	1 (0, 2)		4 (3, 5)		2 (1, 4)		2 (1, 4)		1 (0, 2)		1 (0, 2)		1 (0, 2)		13 (7, 22)	
≥ 2 co-morbidities	2 (0, 4)		5 (3, 6)		2 (1, 5)		3 (1, 5)		2 (0, 4)	‡	1 (0, 3)		1 (0, 3)		17 (8, 29)	
Clinical types*																
Keratotic¶	1 (0, 2)	0.116	4 (2, 4)	0.000*	2 (0, 4)	0.084	1 (0, 3)	0.006	1 (0, 3)	0.129	0 (0, 2)	0.001*	1 (0, 2)	0.082	10 (4, 21)	0.006*
Erythematous††	2 (0, 3)		4 (3, 6)		3 (1, 4)		3 (1, 4)	¶	2 (0, 4)		1 (0, 3)		1 (0, 2)		15 (8, 24)	
Erosive/ulcerative	2 (0, 3)		6 (4, 7)	¶,*,††	3 (1, 5)		4 (2, 5)	*	2 (1, 5)		2 (1, 4)	¶,*,††,*	2 (1, 3)		20 (11, 31)	¶,*
Extraoral LP¶																
No	1 (0, 3)		4 (3, 6)		2 (0, 4)		2 (0, 4)		2 (0, 3)		1 (0, 3)		1 (0, 2)		15 (7, 24)	
Yes/genital	2 (0, 4)	0.54	4 (4, 6)	0.302	3 (2, 5)	0.054	3 (0, 6)	0.388	2 (1, 4)	0.09	1 (0, 3)	0.603	1 (0, 3)	0.535	15 (7, 29)	0.3
Yes/skin	2 (1, 4)	0.06	5 (3, 7)	0.16	3 (2, 5)	0.01	4 (2, 6)	0.003*	3 (1, 4)	0.06	2 (1, 3)	0.03	2 (0, 4)	0.115	20 (12, 33)	0.01
Treatment‡																
No/only Tanes¶	0 (0, 1)	0.000*	2 (0, 4)	0.000*	1 (0, 2)	0.000*	0 (0, 2)	0.000*	0 (0, 1)	0.000*	0 (0, 1)	0.000*	0 (0, 1)	0.000*	5 (2, 10)	0.000*
TCS alone††	2 (0, 3)	¶,*	4 (3, 6)	¶,*	2 (1, 5)	¶,*	3 (1, 4)	¶,*	2 (0, 4)	¶,*	1 (0, 3)		1 (0, 2)		16 (8, 24)	
TCS + other TTx	3 (1, 4)	¶,*,††	6 (4, 7)	¶,*,††	4 (2, 5)	¶,*	4 (3, 6)	¶,*,††	3 (1, 4)	¶,*,††	2 (1, 4)	¶,*	2 (1, 3)	¶,*	22 (13, 30)	¶,*,††
TTx + STx	3 (0, 4)	¶	5 (4, 7)	¶,*	2 (0, 4)		3 (1, 6)	¶,*	3 (1, 4)	¶	3 (0, 6)	¶,*	2 (1, 4)	¶	21 (6, 36)	
Age (years)§	−0.065	0.262	−0.074	0.2	−0.188	0.001*	−0.078	0.179	−0.125	0.031	−0.138	0.017	-0.087	0.131	−0.137	0.018
Disease duration (years)§	0.038	0.507	0.065	0.262	−0.034	0.564	−0.042	0.474	−0.032	0.586	−0.026	0.651	-0.013	0.825	−0.017	0.766
NRS for pain§	0.49	0.000*	0.632	0.000*	0.461	0.000*	0.588	0.000*	0.526	0.000*	0.477	0.000*	0.455	0.000*	0.622	0.000*
HADS-Anxiety§	0.429	0.000*	0.377	0.000*	0.465	0.000*	0.394	0.000*	0.536	0.000*	0.446	0.000*	0.52	0.000*	0.534	0.000*
HADS-Depression§	0.432	0.000*	0.386	0.000*	0.461	0.000*	0.427	0.000*	0.493	0.000*	0.419	0.000*	0.481	0.000*	0.528	0.000*
HADS-total§	0.468	0.000*	0.42	0.000*	0.513	0.000*	0.442	0.000*	0.567	0.000*	0.473	0.000*	0.551	0.000*	0.583	0.000*
PSS-10§	0.366	0.000*	0.383	0.000*	0.453	0.000*	0.37	0.000*	0.508	0.000*	0.45	0.000*	0.475	0.000*	0.508	0.000*

(*continued on next page*)

Table 2 (*Continued*)

Study variables	FL		PhyP		PsyD		PhyDis		PsyDis		SD		H		Total score	
	Med (IQR)	*P*	Med (IQR)	*P*	Med (IQR)	*P*	Med (IQR)	*P*	Med (IQR)	*P*	Med (IQR)	*P*	Med (IQR)	*P*	Med (IQR)	*P* value
ODSS total[§]	0.381	0.000*	0.534	0.000*	0.378	0.000*	0.482	0.000*	0.369	0.000*	0.373	0.000*	0.326	0.000*	0.494	0.000*
ODSS-site[§]	0.272	0.000*	0.355	0.000*	0.266	0.000*	0.349	0.000*	0.254	0.000*	0.237	0.000*	0.211	0.000*	0.343	0.000*
ODSS-activity[§]	0.307	0.000*	0.448	0.000*	0.313	0.000*	0.4	0.000*	0.286	0.000*	0.319	0.000*	0.271	0.000*	0.405	0.000*
All subjects	2 (0, 3)		4 (3, 6)		2 (1, 4)		2 (0, 4.5)		2 (0, 4)		1 (0, 3)		1 (0, 2)		15 (7, 25)	

Bold value = *P*-value < 0.05.

STx, systemic treatment; Tanes, topical anaesthetic agents; TCS, topical corticosteroids; TTx, topical treatment.

† Mann–Whitney *U*-test.

‡ Kruskal–Wallis test.

§ Spearman's rho correlation coefficients.

☚ Significant difference with the first reference group.

‡‡ Significant difference with the second reference group.

* Statistical significance at Bonferroni-corrected *P*-value of 0.003.

higher intensity of oral pain than those with normal psychological state[23]. Therefore, clinicians should not only focus on the treatment of visible clinical signs of OLP alone. Concomitant evaluation and appropriate management of psychological factors influencing the pain experience in patients with OLP may improve patient care.

The present analysis revealed that the increase in level of perceived stress and anxiety symptoms in OLP patients was an independent predictor for worse overall QoL, and this corroborates the finding of one recent study on OLP patients resident in Poland[29]. Based upon multivariate models of subscale COMDQ-15 scores, the findings demonstrate that patients with a greate psychological stress have a tendency to have a greater psychosocial burden ($P < 0.001$), more perceived PD ($P = 0.006$) from OLP, and less perceived support and understanding from family members and friends ($P = 0.016$). Together with psychological stress, anxiety symptoms also negatively contribute to worse general oral health-related QoL and increased psychosocial burden of OLP. In contrast, depressive symptoms did not persist as an independent determinant of QoL after adjusting for other factors, and this differs from the findings of previous research[29,30]. Considering the influence of psychological factors on various aspects of patients' QoL, more attention should be paid to the screening of psychological symptoms using validated psychological measures in the management of OLP. Importantly, if abnormal psychological symptoms are detected, it is the clinician's responsibility to make timely onward referral to the general practitioner or appropriate specialist teams, which may include clinical psychologists or psychiatrists, in order to help improve the QoL of patients with OLP.

Clinical types of OLP appeared not to predict QoL outcomes in this OLP patient group once other confounders were controlled, and this did not support findings of previous studies[8,27]. Nevertheless, it was observed that a higher score of disease activity as assessed by the ODSS-activity score was an important determinant of worse QoL including the 'PD' domain ($P = 0.007$) and total COMDQ-15 scores ($P = 0.009$), although the present results did not reach significance ($P < 0.003$). This was in agreement with a recent study of Brazilian patients with OLP, which found that patients with greater disease activity reported worse QoL outcomes as indicated by the total OHIP-14 score[31]. This finding underlines the important role of disease activity control to improve overall QoL outcomes particularly by lessening physical impact of the OLP lesions on daily oral activities in this patient group.

The present multivariate analysis showed Asian ethnicity was significantly associated with worse QoL in the domains 'MT' and 'SE' of the COMDQ-15 when compared with white ethnicity. In other words, Asian patients with OLP in this cohort were more likely to report a greater impact of OLP on their lives including concerns about medication and psychosocial burden than the major ethnic group. This might reflect potential sociocultural confounding factors including cultural difference in QoL perception, socioeconomic minority and communication problems, and access to health care of this patient population in the UK. However, further studies exploring the ethnic factors on the perception of QoL in patients with OLP is required.

Table 3 – Results of the univariate and multivariate linear regression analyses of the total and subscale COMDQ-15 scores

Dependent variables	Independent variables[†]	Univariate model				After adjusted for demographic variables[‡]				Multivariate model				
		Unstandardised		Standardised coefficient β	*P*-value	Unstandardised		Standardised coefficient β	*P*-value	Unstandardised		Standardised coefficient β	*P*-value	Adjusted R^2
		B	S.E.			*B*	S.E.			*B*	S.E.			
Total COMDQ-15	*Pain: NRS*	3.24	0.22	0.65	0.000*	2.93	0.23	0.58	0.000*	1.78	0.24	0.36	0.000*	0.6
	Treatment: TCS & other TTx	17.37	2.14	0.58	0.000*	15.95	2.04	0.53	0.000*	7.2	1.72	0.24	0.000*	
	Treatment: TCS	12.39	1.83	0.49	0.000*	12.29	1.76	0.49	0.000*	5.98	1.44	0.24	0.000*	
	Stress: PSS-10	0.86	0.08	0.53	0.000*	0.76	0.08	0.47	0.000*	0.35	0.09	0.22	0.000*	
	OLP activity: ODSS-activity	0.75	0.11	0.38	0.000*	0.68	0.1	0.34	0.000*	0.26	0.1	0.13	0.009	
	Ethnicity: Asian	8.6	1.56	0.31	0.000*	8.31	1.72	0.3	0.000*	2.8	1.21	0.1	0.021	
	Extraoral LP: skin LP	6.46	2.12	0.17	0.002*	6.06	2.01	0.16	0.003	3.19	1.45	0.09	0.028	
	Treatment: systemic treatment	15.07	3.89	0.22	0.000*	14.67	3.72	0.21	0.000*	6.19	2.9	0.09	0.034	
Physical discomfort	*Pain: NRS*	1.32	0.09	0.65	0.000*	1.29	0.09	0.64	0.000*	0.84	0.11	0.42	0.000*	0.53
	Treatment: TCS & other TTx	7.74	0.84	0.64	0.000*	7.29	0.84	0.6	0.000*	3.67	0.75	0.3	0.000*	
	Treatment: TCS	5.31	0.72	0.52	0.000*	5.25	0.73	0.52	0.000*	2.66	0.63	0.26	0.000*	
	Stress: PSS-10	0.27	0.03	0.41	0.000*	0.25	0.04	0.38	0.000*	0.11	0.04	0.16	0.006	
	OLP activity: ODSS-activity	0.33	0.04	0.41	0.000*	0.31	0.04	0.38	0.000*	0.12	0.04	0.15	0.007	
	At least 2 disease co-morbidities	2.47	0.78	0.24	0.002*	2.62	0.83	0.26	0.002*	1.26	0.57	0.12	0.028	
Medication Sc treatment	*Pain: NRS*	0.63	0.06	0.5	0.000*	0.54	0.07	0.42	0.000*	0.33	0.08	0.26	0.000*	0.36
	Treatment: TCS	2.88	0.48	0.45	0.000*	2.89	0.47	0.45	0.000*	1.59	0.46	0.25	0.001*	
	Treatment: TCS & other TTx	3.38	0.56	0.44	0.000*	3.06	0.54	0.4	0.000*	1.33	0.55	0.18	0.015	
	Ethnicity: Asian	2.26	0.4	0.32	0.000*	2.09	0.44	0.29	0.000*	1.18	0.38	0.17	0.002*	
	Treatment: systemic treatment	3.6	1.03	0.21	0.001*	3.51	0.99	0.2	0.000*	1.79	0.92	0.1	0.05	
Social & emotional	*Pain: NRS*	1.11	0.1	0.53	0.000*	0.94	0.1	0.45	0.000*	0.53	0.11	0.25	0.000*	0.5
	Anxiety: HADS-A	0.65	0.06	0.55	0.000*	0.57	0.06	0.48	0.000*	0.27	0.07	0.22	0.000*	
	Stress: PSS-10	0.37	0.03	0.55	0.000*	0.32	0.03	0.48	0.000*	0.13	0.04	0.2	0.001*	
	Treatment: TCS & other TTx	5.47	0.93	0.44	0.000*	4.84	0.89	0.39	0.000*	2.12	0.79	0.17	0.008	
	Ethnicity: Asian	3.91	0.64	0.34	0.000*	3.62	0.71	0.31	0.000*	1.71	0.54	0.15	0.002*	
	Treatment: TCS	3.48	0.8	0.33	0.000*	3.44	0.76	0.33	0.000*	1.48	0.66	0.14	0.025	
Patient support	Stress: PSS-10	0.07	0.02	0.26	0.000*	0.07	0.02	0.24	0.000*	0.06	0.02	0.2	0.016	0.08
	Older age	−0.03	0.01	−0.15	0.01	−0.03	0.01	−0.16	0.012	−0.03	0.01	−0.14	0.018	

Bold value = *P*-value < 0.05.

Italic variables are significant variables at multivariale model.

TCS, topical corticosteroids; TTx, topical treatment.

[†] Only independent variables with *P*-value less than 0.05 in multivariate model are displayed in the table.

[‡] Adjusted for age, sex, ethnicity, smoking, alcohol consumption and number of disease co-morbidities.

* Statistical significance at Bonferroni-corrected *P*-value < 0.003.

Table 4 – Results of the univariate and multivariate linear regression analyses of the total and subscale OHIP-14 scores

Dependent variables	Independent variable[†]	Univariate model				After adjusted for demographic variables[‡]				Multivariate model				
		Unstandardised		Standardised coefficient β	P-value	Unstandardised		Standardised coefficient β	P-value	Unstandardised		Standardised coefficient β	P-value	Adjusted R^2
		B	S.E.			*B*	S.E.			*B*	S.E.			
Total OHIP-14	*Pain: NRS*	3.11	0.24	0.61	0.000*	2.8	0.24	0.55	0.000*	1.65	0.26	0.32	0.000*	0.56
	Anxiety: HADS-A	1.64	0.14	0.56	0.000*	1.45	0.15	0.49	0.000*	0.67	0.18	0.23	0.000*	
	Treatment: TCS & other TTx	15.09	2.27	0.49	0.000*	14.03	2.16	0.46	0.000*	5.73	1.86	0.19	0.002*	
	Depression: HADS-D	1.88	0.17	0.55	0.000*	1.7	0.18	0.49	0.000*	0.54	0.2	0.16	0.007	
	Treatment: TCS	9.97	1.94	0.39	0.000*	10.26	1.86	0.4	0.000*	3.93	1.55	0.15	0.012	
	OLP activity: ODSS-activity	0.7	0.11	0.34	0.000*	0.62	0.11	0.3	0.000*	0.27	0.11	0.13	0.012	
Functional limitation	*Pain: NRS*	0.36	0.04	0.47	0.000*	0.33	0.04	0.42	0.000*	0.2	0.05	0.26	0.000*	0.34
	Anxiety: HADS-A	0.19	0.02	0.44	0.000*	0.17	0.02	0.38	0.000*	0.09	0.03	0.19	0.008	
	Treatment: TCS & other TTx	2.01	0.35	0.43	0.000*	1.81	0.34	0.39	0.000*	0.8	0.33	0.17	0.017	
	Depression: HADS-D	0.23	0.03	0.45	0.000*	0.2	0.03	0.39	0.000*	0.08	0.04	0.15	0.034	
Physical pain	*Pain: NRS*	0.54	0.04	0.62	0.000*	0.52	0.04	0.6	0.000*	0.36	0.05	0.41	0.000*	0.46
	Treatment: TCS & other TTx	2.87	0.38	0.55	0.000*	2.77	0.37	0.53	0.000*	1.13	0.34	0.22	0.001*	
	Treatment: TCS	1.94	0.32	0.45	0.000*	1.97	0.32	0.45	0.000*	0.81	0.28	0.19	0.005	
	Anxiety: HADS-A	0.19	0.03	0.39	0.000*	0.17	0.03	0.34	0.000*	0.07	0.03	0.15	0.023	
	OLP activity: ODSS-activity	0.14	0.02	0.4	0.000*	0.13	0.02	0.37	0.000*	0.05	0.02	0.13	0.018	
	Treatment: systemic treatment	2.49	0.68	0.21	0.000*	2.53	0.68	0.21	0.000*	1.19	0.57	0.1	0.039	
Psychological discomfort	Depression: HADS-D	0.3	0.03	0.45	0.000*	0.3	0.04	0.45	0.000*	0.13	0.05	0.19	0.006	0.37
	Pain: NRS	0.46	0.05	0.45	0.000*	0.42	0.05	0.42	0.000*	0.18	0.06	0.18	0.003	
	OLP activity: ODSS-activity	0.11	0.02	0.27	0.000*	0.1	0.02	0.25	0.000*	0.06	0.02	0.15	0.014	
	older age	−0.04	0.01	−0.18	0.002*	−0.05	0.01	−0.21	0.001*	−0.03	0.01	−0.15	0.003	
	Treatment: TCS & other TTx	2.18	0.46	0.36	0.000*	2.14	0.45	0.36	0.000*	0.88	0.43	0.15	0.043	
	Stress: PSS-10	0.15	0.02	0.45	0.000*	0.13	0.02	0.41	0.000*	0.05	0.02	0.14	0.045	
Physical disability	*Pain: NRS*	0.6	0.05	0.59	0.000*	0.53	0.05	0.52	0.000*	0.35	0.06	0.34	0.000*	0.46
	Anxiety: HADS-A	0.25	0.03	0.43	0.000*	0.21	0.03	0.35	0.000*	0.11	0.04	0.19	0.005	
	Treatment: TCS & other TTx	3.04	0.45	0.5	0.000*	2.75	0.43	0.45	0.000*	1.04	0.4	0.17	0.011	
	OLP activity: ODSS-activity	0.14	0.02	0.35	0.000*	0.13	0.02	0.32	0.000*	0.06	0.02	0.15	0.01	
	Extraoral LP: skin LP	1.38	0.43	0.18	0.001*	1.38	0.41	0.18	0.001*	0.79	0.34	0.11	0.021	
Psychological disability	*Anxiety: HADS-A*	0.3	0.02	0.57	0.000*	0.26	0.03	0.51	0.000*	0.13	0.03	0.26	0.000*	0.48
	Pain: NRS	0.47	0.05	0.52	0.000*	0.41	0.05	0.44	0.000*	0.22	0.05	0.24	0.000*	
	Treatment: TCS & other TTx	2.29	0.41	0.42	0.000*	2.09	0.39	0.38	0.000*	0.88	0.35	0.16	0.013	
	Depression: HADS-D	0.32	0.03	0.52	0.000*	0.29	0.03	0.48	0.000*	0.1	0.04	0.16	0.013	
	older age	−0.03	0.01	−0.14	0.013	−0.04	0.01	−0.19	0.002*	−0.02	0.01	−0.13	0.009	
	Ethnicity: Black	2.1	0.68	0.18	0.002*	1.74	0.66	0.15	0.002*	1.05	0.52	0.09	0.043	
Social disability	*Pain: NRS*	0.37	0.04	0.46	0.000*	0.34	0.04	0.43	0.000*	0.18	0.05	0.22	0.000*	0.38
	Anxiety: HADS-A	0.21	0.02	0.46	0.000*	0.2	0.03	0.44	0.000*	0.08	0.03	0.18	0.012	
	Treatment: TCS	1.22	0.31	0.3	0.000*	1.32	0.31	0.33	0.000*	0.69	0.28	0.17	0.016	
	Stress: PSS-10	0.13	0.01	0.48	0.000*	0.12	0.01	0.45	0.000*	0.04	0.02	0.16	0.017	
	Treatment: TCS & other TTx	1.62	0.36	0.34	0.000*	1.55	0.36	0.32	0.000*	0.68	0.34	0.14	0.049	
	Treatment: systemic tx	2.25	0.66	0.3	0.001*	2.38	0.66	0.22	0.000*	1.55	0.57	0.14	0.007	

(*continued on next page*)

Table 4 (*Continued*)

Dependent variables	Independent variable[†]	Univariate model				After adjusted for demographic variables[‡]				Multivariate model				
		Unstandardised		Standardised coefficient β	P-value	Unstandardised		Standardised coefficient β	P-value	Unstandardised		Standardised coefficient β	P-value	Adjusted R^2
		B	S.E.			B	S.E.			B	S.E.			
Handicap	*Anxiety: HADS-A*	0.22	0.02	0.52	0.000*	0.2	0.02	0.48	0.000*	0.11	0.03	0.26	0.000*	0.38
	Pain: NRS	0.32	0.04	0.43	0.000*	0.26	0.04	0.36	0.000*	0.16	0.04	0.21	0.000*	
	Depression: HADS-D	0.25	0.02	0.51	0.000*	0.22	0.03	0.46	0.000*	0.08	0.03	0.15	0.023	

Bold value = *P*-value < 0.05.
Italic variables are significant variables at multivariate model.
TCS, topical corticosteroids; TTx, topical treatment.
† Only independent variables with *P*-value < 0.05 in multivariate model are displayed in the table.
‡ Adjusted for age, sex, ethnicity, smoking, alcohol consumption and number of disease co-morbidities.
* Statistical significance at Bonferroni-corrected *P*-value < 0.003.

Apart from the demographic, psychological and disease-related variables, different choices of treatment prescribed were found to have an influence on patients' QoL when compared with patients who did not receive any treatment or received topical anaesthetic agents only. The present finding showed that those receiving topical corticosteroids with other adjuvant medications were likely to report worse overall QoL including the 'PD' domain of the COMDQ-15 than those receiving topical corticosteroids alone and those receiving no active treatment. The use of systemic medications did not predict the 'PD' domain, but was found to increase scores of the total COMDQ-15 ($P = 0.034$) and 'MT' domain of the COMDQ-15 ($P = 0.05$). The 'MT' score of the COMDQ-15 is indicative of patients' concerns about OLP treatment, including the side-effects, limitation from routine use as well as frustration of no standard medication. As QoL in patients with OLP is not dependent on the impact of the disease alone, the use of a QoL measure such as the COMDQ-15 could provide informative data on patients' concerns about the impact of treatment, which might not be expressed during routine consultation. Understanding a patient's concerns could improve shared decision-making and reassurance about treatment during consultations, and consequently improve the quality of care provided to the patients.

The vast majority of the clinical research and practice with OLP presently use non-specific patient-reported instruments for the assessment of subjective constructs such as pain, anxiety, depression or QoL including the NRS, the HADS or the OHIP-14[10]. Although these instruments are useful for comparison between different patient groups, they may not always provide sufficient detail and appeared to be less sensitive to detect small but clinically meaningful changes associated with OLP. The present results also found that QoL as measured by the OHIP-14 was found to have a poorer association with symptoms and signs of patients with OLP when compared with the use of COMDQ-15, which is a QoL measure specific to patients with oral mucosal conditions including OLP. Currently there are a number of specific instruments developed with the input from patients with OLP. These include the Oral Lichen Planus Symptom Severity Measure to assess daily experience of physical symptoms of OLP[32], the COMDQ to quantify the level of QoL specific to chronic oral mucosal conditions, and the OPMDQoL to measure QoL specific to oral potentially malignant disorders[12]. Utilising these instruments could help clinicians and researchers assessing subjective constructs specific to patients with OLP with confidence.

The main strength of this study is the sample size, which is notably larger than previous clinical studies of QoL in OLP, and all of the instruments used have been validated for use in patients with OLP. Moreover, potential confounding factors were controlled by means of multivariate analysis. However, a number of study limitations should be noted. Several socio-economic factors, which have some evidence supporting their influence on patient's perception of QoL, such as level of education, level of income and job status, were not assessed in this study. In addition, time since treatment, which may influence 'MT' subscale scores of the COMDQ-15, was not taken into consideration in the present study. The OLP cohort in this study was based upon patients in one tertiary referral Oral Medicine centre, and thus may not represent the whole

OLP population, including asymptomatic cases of OLP. Due to the limitation of cross-sectional design, the present results did not reflect the long-term course and relapsing/remitting behaviour of OLP, but rather represent a snapshot of the disease status and patient experience over the past month before study visits. Therefore, it is theoretically possible that a patient with a relatively quiescent long-term course of OLP may experience a short-term aggravation of the disease at the time of the study visits and thus may report having poorer perception of their current QoL. The exclusion of non-English speakers may also lessen external validity of the study.

In conclusion, the reduced QoL of patients with OLP, although associated with a number of several demographic, psychological and clinical determinants, seems to be particularly affected by high pain levels, high anxiety levels and use of topical corticosteroids. The COMDQ-15 is best suited to measure levels of QoL in this population.

Author contributions

Paswach Wiriyakijja and Richeal Ni Riordain designed the study. Paswach Wiriyakijja collected data from OLP patients, performed the statistical analyses reported in the study and wrote the manuscript. Richeal Ni Riordain, Martina Shephard, Roddy McMillan, Tim Hodgson, Stefano Fedele and Stephen Porter edited and contributed comments on the manuscripts.

Conflict of interest

The authors declare no conflicts of interest in relation to this work.

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