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ORIGINAL RESEARCH

Quality of Life in Patients Affected by Facial Basal Cell Carcinoma: Prospective Longitudinal Pilot Study and Validation of Skin Cancer Index in Lithuanian Language

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Purpose: Facial basal cell carcinoma (BCC) poses significant challenges due to its potential for local destruction and impact on quality of life (QoL). Continuous research is necessary to identify novel factors influencing the quality of life within this demographic across diverse cultural settings. The aims of this study were to translate, culturally adapt, and validate the Lithuanian version of Skin Cancer Index, subsequently utilizing this questionnaire in the pilot phase of the study to achieve the following: (1) identify the differences in short- and long-term QoL, (2) establish empirical correlations between SCI scores and aesthetic facial regions, evaluate the potential differences between age, gender, and tumor size groups.

Patients and Methods: A prospective longitudinal study was conducted with 100 consecutive patients. The SCI was translated into Lithuanian language, with a rigorous assessment of its psychometric properties to confirm validity. Alongside hypothesis testing, a detailed analysis of variables was conducted. Statistical techniques, including t-tests and ANOVA, were employed to compare scores across demographic and clinical groups, with effect size calculations for further interpretation.

Results: Our findings demonstrate that the Lithuanian SCI successfully fulfills the criteria established by the COSMIN checklist. Surgical treatment for facial BCC notably enhances QoL, particularly evident six months post-surgery. Analysis of SCI scores identified demographic and clinical factors associated with lower QoL, including female gender, treatment with skin plasty, and tumor sites in aesthetically sensitive areas like the cheek, nose, and eyelid.

Conclusion: The Lithuanian version of the SCI is a reliable and valid tool for assessing QoL in facial BCC patients. Our findings underscore the global relevance of understanding the multifactorial influences on QoL in BCC patients. Early diagnosis, less invasive treatment approaches, and tailored post-operative care are crucial in minimizing the psychological, social, and appearance-related burdens of facial BCC.

Keywords: skin cancer, face surgery, outcomes, skin cancer surgery, health-related quality of life, PROM

Introduction

Non-melanoma skin cancer (NMSC) continues to be the most common neoplasm, with the majority of NMSC cases attributed to facial basal cell carcinoma (BCC).[1,2] The frequency of this widespread malignancy has significantly risen over the recent decades[3–5] with a projected continued increase until 2040.[6,7] Understanding predictors of treatment success is crucial for improving clinical outcomes worldwide.

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Despite its rare metastatic potential,[8] BCC can cause substantial local destruction, leading to disfigurement and potentially impacting large areas of soft tissue, cartilage, and bone. Not only does it result in premature morbidity and mortality,[9] but also greatly affects the Quality of Life (QoL).[10,11] Our previous investigation into QoL studies of individuals, affected by head and neck BCC, revealed a significant research gap in analyzing the multifaceted relationships between QoL and factors such as tumor size, specific facial regions, and surgery types.[12]

While the distribution of BCC in particular facial regions has been previously described,[13,14] it has never been associated with Health-Related Quality of Life (HRQoL). It is plausible to suggest that the prevalence of aesthetically sensitive face areas may have a more pronounced impact on QoL than other locations. While the lesion itself is likely to cause significant distress, the need for facial surgery due to malignancy poses a different level of unease. Surgical treatment can range from minimally invasive procedures[15] to major tumor excisions, requiring extensive reconstructions.[16] Nevertheless, it is crucial to take into consideration the largest group of patients treated in skin cancer departments - those undergoing conventional excision[17] with options such as primary closure, local flap, or full-skin graft reconstruction. The interventions entail a different level of discomfort and affect various life aspects, potentially leading to certain alterations in QoL.

The Skin Cancer Index (SCI) is the first specific patient-reported outcome measure (PROM) evaluating the QoL in patients with cervicofacial NMSC.[18] In contrast to the widely used Dermatology Life Quality Index (DLQI) or FACE-Q questionnaire, the SCI capturing the emotional and appearance-related domains has been reported to exhibit the highest level of support for its efficacy, sensitivity, and applicability.[19–21] To date, SCI has been translated and validated from its original (English)[22] into Portuguese,[23] Brazilian Portuguese,[24] Italian,[25] and Spanish[23] languages. To use the assessment tool on Lithuanian patients, it is crucial to examine different aspects of the scale's validity within the Lithuanian patient sample.

The aims of this prospective longitudinal pilot study were to (1) translate, culturally adapt, and validate the Lithuanian version of SCI, (2) identify the differences in short- and long-term QoL, (3) establish empirical correlations between SCI scores and aesthetic facial regions, and evaluate the potential differences between age, gender, and tumor size groups.

Patients and Methods

Procedures and Ethics Statement

The permission to translate and validate the SCI in the Lithuanian language was granted by the scale developers in 2022. The study was carried out under the Lithuanian Bioethics Committee Approval (Approval No. 2022/11-1476-943). In alignment with the Declaration of Helsinki, all study participants provided written informed consent.

Data was collected from 23rd November 2022, to 16th October 2023 at the Vilnius University Hospital Santaros Klinikos Centre of Dermatology (VUH).

Patients

Adhering to the suggested sample size for robust PROM statistical analysis,[26,27] we enrolled a total of 100 consecutive patients in the study. Participants were included based on the following criteria:

- Age ≥18 years.
- Individuals presenting for surgical treatment of clinically suspected or histologically confirmed facial BCC.
- Ability to comprehend Lithuanian language.

Participants with substantial cognitive impairment or a limited understanding of the Lithuanian language were excluded from the study.

Data on patient socio-demographic and clinical details were collected. Demographic variables comprised age, gender, marital status, education, place of residence, employment status, and frequency of interactions with family members. Clinical aspects involved the largest tumor diameter, its precise location, and surgery type. Tumors were categorized into specific regions based on their localization using the Facial Aesthetic unit Classification proposed by TT Fattahi.[28] Patients were further classified into three distinct groups based on the type of surgery: (E) excision, (P) skin plasty

reconstruction by local flaps, and (T) skin graft transplantation. The surgeries were performed following a standardized protocol as day care procedures by a plastic and reconstructive surgeon with and extensive experience in the field.

Administered Outcome Measures

Skin Cancer Index (SCI)

SCI is a skin-cancer-specific QoL measurement instrument with a focus on emotional, social, and appearance aspects. It consists of 15 Likert scale questions, with scores ranging from 1 (very much – indicating a significant impact on quality of life) to 5 (not at all – suggesting no impact on quality of life). The total ranges from 15 to 75 points, with a higher score indicating a better quality of life.

Dermatology Life Quality Index (DLQI)

DLQI is designed to assess the impact of a skin condition on a patient's life over the past week. Comprising 10 questions, respondents rate their experiences on a scale of 0 to 3 (0 indicating no impact, 1 for a slight impact, 2 for a significant impact, and 3 for a substantial impact). The cumulative score, ranging from 0 to 30, provides an overall measure of the impact of the skin problem on the QoL. The higher total score signifies a greater effect of the dermatological disease on the patient's life.

The World Health Organization- Five Well-Being Index (WHO-5)

The WHO-5 questionnaire consists of 5 Likert scale questions that capture the respondent's subjective experience of well-being over the preceding two weeks. The total score ranges from 0 to 100, with a higher indicating a better sense of well-being. The WHO-5 does not encompass all elements of QoL. However, it is often used as a screening tool providing valuable insights into overall quality of life, especially in terms of mental and emotional aspects.

PROM Administration

The paper-based or digital SCI, DLQI, and WHO-5 questionnaires were completed by 100 patients at different time points: (1) the day of surgery, (2) 4 weeks, and (3) 6 months post-operatively. A subgroup of 50 participants additionally filled out the SCI a week before their second appointment.

Translation and Cultural Adaptation

The translation and cultural adaptation process of SCI followed the guidelines outlined by the ISPOR Task Force for Translation and Cultural Adaptation (ISPOR TCA)[29] and the COSMIN Study Design checklist.[26,27] Initially, the scale was translated from its original English version into Lithuanian by several members of the VUH, fluent in both Lithuanian and English. The forward translation was also conducted by an experienced plastic surgeon. The preliminary samples were then reviewed by a Lithuanian team of 5 resident doctors, 5 nurses, and 5 dermatovenereologists. After a comprehensive examination and discussion, a consensus was reached, resulting in the most suitable version of the forward translation. Backward translation into the English language was performed by two dermatologists who were not familiar with the original version. Minor language adjustments were made after comparing the two versions with the original.

The cognitive debriefing process was carried out on a subgroup of 15 patients presenting to VUH with NMSC. The patients were given the SCI scales and asked about any words that might be hard to comprehend, be susceptible to misinterpretation, or have the potential to be offensive. Additionally, the questions were evaluated regarding their relevance to each subscale. Following a thorough review and refinement based on the cognitive debriefing feedback, a consensus was achieved, leading to the final Lithuanian version of SCI.

Statistical Analysis

The statistical analysis was performed using R Statistical Software (version 4.2.2; R Foundation for Statistical Computing, Vienna, Austria) and MedCalc Software Ltd (Ostend, Belgium; https://www.medcalc.org; 2024). The existence of floor/ceiling effects was acknowledged when >15% of subjects scored at the lowest or highest extremes. A $p<0.05$ was considered as statistically significant.

Internal Consistency

Cronbach's alpha coefficient was calculated to assess the internal consistency among items on the Emotional, Social, and Appearance subscales at 3 time points. Coefficient values between 0.70 and 0.95 were considered to be adequate.[30,31]

Structural Validity

Due to the scale being based on a reflective model, the three-factor confirmatory factor analysis (CFA) was performed. The thresholds for the good CFA fit were as follows: Comparative Fit Index (CFI) >0.90 adequate and >0.95 good; Tucker Lewis Index (TLI) (>0.90 adequate and >0.95 good; Root Mean Square Error of Approximation (RMSEA) <0.08; Standardized Root Mean Squared Residual (SRMR) <0.08, and chi squared ($\chi 2$)/degrees of freedom (df) with the desired range of 2–5.[32]

Criterion Validity

Spearman's rank correlation coefficient (ρ) was calculated between each subscale and total scores. The coefficient values were considered as follows: very strong 0.80–1, strong 0.6–0.799, medium 0.4–0.599, weak 0.2–0.399, very weak 0–0.199.

Construct Validity

To assess convergent validity, Spearman's rank correlation coefficient was analyzed between SCI-I, DLQI-I, and WHO-5-I scales. The hypotheses were established a priori:

1. Positive correlation between SCI-I emotional subscale and WHO-5-I.
2. Negative correlation between SCI-I emotional subscale and DLQI-I.
3. Positive correlation between SCI-I social subscale and WHO-5-I.
4. Negative correlation between SCI-I social subscale and DLQI-I.
5. Positive correlation between SCI-I appearance subscale and WHO-5-I.
6. Negative correlation between SCI-I appearance subscale and DLQI-I.

Convergent construct validity was considered appropriate when at least 75% of the expected correlations with other related measures were confirmed.[33]

Measurement Error and Reliability

The questionnaire was filled out twice by a subgroup of 50 patients in an interval of 5–7 days. Patients were given either paper or digital SCI questionnaires with identical instructions during both the initial and second administrations of the scale. The initial completion of the SCI took place at home, while the second occurred in the hospital—this being the sole point of distinction. The subgroup was additionally questioned about the possible factors that could influence the change of answers in the interim period.

Test–retest reliability (TRR) was assessed by calculating the Intraclass Correlation Coefficient (ICC, two-way mixed-effects model, absolute agreement, 95% CI). ICC values of >0.70 were considered acceptable.[33]

The standard deviation of differences (SDdif) was calculated to evaluate the dispersion of the differences between test and retest (TR) scores. A smaller SDdif was considered suggestive of good agreement between TR scores. The standard error of measurement (SEM) was calculated with the following formula: $SEM = SDdif\sqrt{(1-ICC)}$. The formula used to determine the smallest detectable change in an individual (SDCind) is expressed as follows: $SDCind = 1.96 \times \sqrt{2} \times SEM$. The smallest detectable change measurable in a group of people (SDCgroup) was calculated by dividing SDCind by $\sqrt{n}$, where n represents the sample size.[33] The mean of the differences between test–retest scores was computed by the mean difference score (MD). Limits of Agreement (LoA) were calculated by the following formula: MD ± 1.96 * SDdif.

Sensitivity to Change and Responsiveness

The sensitivity to change was assessed by calculating the effect size (ES), consecutively interpreting the results using Cohen's standard values: 0.2-<0.5 low, 0.5–0.8 moderate, and ≥0.8 large effect size. Additionally, the standardized response mean (SRM) was calculated between the 1st and 2nd, 1st and 3rd, as well as 2nd and 3rd visits. P values of <0.05 were considered significant. It was hypothesized that the SCI will show a significant increase in scores from pre- to post-intervention, indicating its responsiveness to intervention-induced variations. The null hypothesis assumed no significant

difference, while the alternative hypothesis predicted a meaningful change in scores post-intervention, affirming the questionnaire's sensitivity to the effects of the intervention.

The questionnaire's responsiveness was evaluated by conducting statistical comparisons, including *t*-tests and analysis of variance (ANOVA) followed by post hoc tests, to compare scores across various groups.

Segment Analysis and SCI Score Differences Across Anatomic Units

Possible SCI score differences by age, gender, tumor size, aesthetic facial units, and surgery groups (E, P, T) at 1st, 2nd, and 3rd visits were analyzed. The Student's *t*-test was used for dichotomous variables and Analysis of Variance for categorical variables with three or more groups. Where ANOVA was statistically significant, post hoc tests were used to find which groups had reliably different means. Additionally, Cohen's effect size was calculated to quantify the magnitude of group differences.

Results

One hundred consecutive patients were included in the study. The questionnaires were completed by all study participants at 3 time points. A subgroup of 50 underwent the re-assessment of the reliability evaluation for SCI. A very small percentage of missing values (0.003%) was noted. They were replaced by applying the Mode Imputation method. The Floor and ceiling effects were negative in SCI and WHO-5 questionnaires, with 28 patients reaching floor effect for DLQI. Demographic and clinical information is presented in Tables 1 and 2.

Table 1 Patient Sociodemographic Characteristics

Sociodemographic characteristics, n=100	
Age	68.35 ± (12.56)
Gender, n (%)	
Male	29 (29%)
Female	71 (71%)
Marital status, n (%)	
Single	4 (4%)
Dating but living separately	1 (1%)
Married	57 (57%)
Living together with a partner	3 (3%)
Divorced	10 (10%)
Widow/widower	25 (25%)
Education, n (%)	
Primary	2 (2%)
Basic (8–10 grades)	6 (6%)
Secondary (11–12 grades)	11 (11%)
Non-university higher education	28 (28%)
University degree	47 (47%)
Other (professional schools)	6 (6%)

(*Continued*)

Table 1 (Continued).

Sociodemographic characteristics, n=100	
Residence, n (%)	
Village (<500 inhabitants)	5 (5%)
Town (500–3000 inhabitants)	7 (7%)
City (>3000 inhabitants)	88 (88%)
Employment, n (%)	
Employed	31 (31%)
Employed (home office)	1 (1%)
Employed but retired	2 (2%)
Unemployed	8 (8%)
Retired	58 (58%)
Do you have children/close relatives? n (%)	
Yes	94 (94%)
No	6 (6%)
Do you often meet them? n (%)	
Yes	92 (92%)
No	8 (8%)

Notes: The groups of sociodemographic characteristics are marked in bold.

Table 2 Patient Clinical Characteristics

Clinical characteristics, n=100	
Largest tumor diameter, mm	9.22 ± (4.80); range: 3–30
Tumor size groups, n (%)	
0–5 mm	21 (21%)
6–10 mm	51 (51%)
11–15 mm	18 (18%)
>15 mm	10 (10%)
Tumor location by TT Fattahi, n (%)	
1 Forehead unit	27 (27%)
1a central subunit	8
1b lateral subunit	19
2 Nasal unit	26 (26%)
2.1 tip subunit	8
2.3,6 right and left alar base subunits	7

(*Continued*)

Table 2 (Continued).

Clinical characteristics, n=100	
2.4,5 right and left alar side wall subunits	4
2.7 dorsal subunit	3
2.8,9 right and left dorsal side wall subunits	4
3 Eyelid unit	11 (11%)
3a lower lid subunit	5
3c lateral canthal subunit	1
3d medial canthal subunit	5
4 Cheek unit	28 (28%)
4a medial subunit	16
4b zygomatic subunit	2
4c lateral subunit	4
4d buccal subunit	6
5 Upper lip unit	7 (7%)
5b lateral subunit	7
7 Mental unit	1 (1%)
Surgery groups, n (%)	
E	49 (49%)
P	39 (39%)
T	12 (12%)

Notes: Surgery groups: E – primary excision, P – skin-plasty, T – skin transplantation. The groups of clinical characteristics are marked in bold.

Translation and Cultural Adaptation

The development of the Lithuanian Skin Cancer Index involved forward translation, backward translation, and a cognitive debriefing process. These procedures collectively ensured linguistic accuracy and cultural appropriateness, ultimately confirming the face and content validity of the scale.

Internal Consistency

The analysis yielded satisfactory Cronbach's alpha values for each subscale at the 1st, 2nd, and 3rd time points (Table 3). The results demonstrate a strong internal coherence among the questionnaire items, affirming the reliability of the

Table 3 Internal Consistency of the SCI

Subscale	**SCI – I**	**SCI – II**	**SCI – III**
Emotional	0.912	0.892	0.863
Social	0.705	0.769	0.7
Appearance	0.849	0.904	0.868

Abbreviation: SCI – I, Skin Cancer Index scores at the 1st visit; SCI– II, Skin Cancer Index scores at the 2nd visit; SCI – III, Skin Cancer Index scores at the 3rd visit.

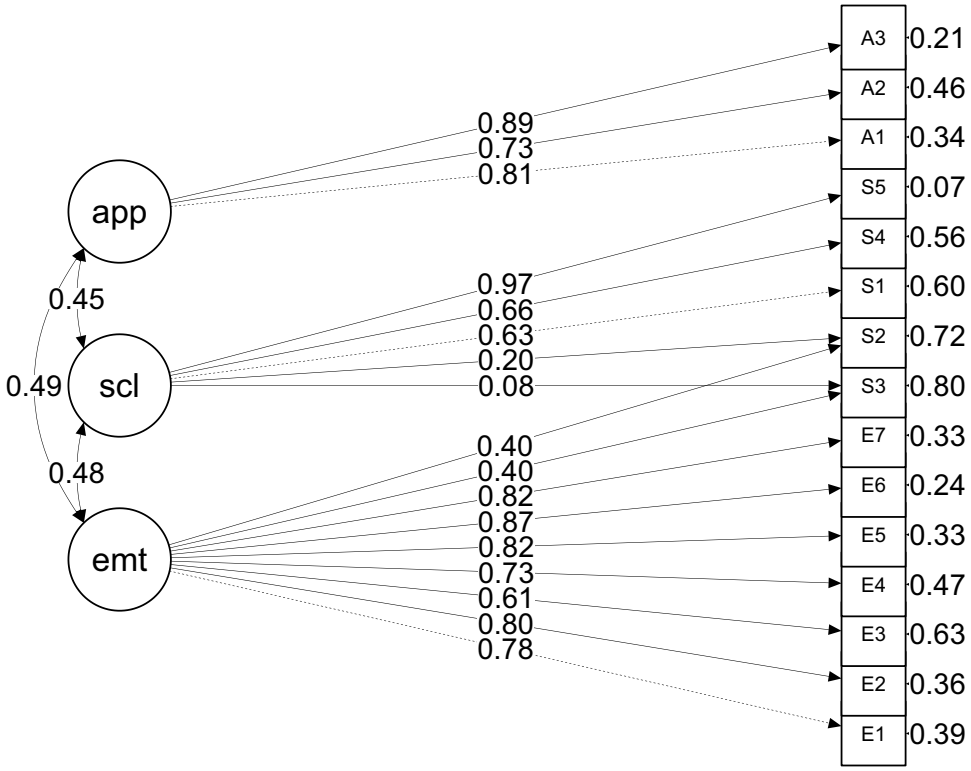

Figure 1 Graphical representation of the refined model (Model 3), with standardized values.

instrument for assessing the intended variables. It reinforces the trustworthiness of the collected data for subsequent analyses and interpretation in our study.

Structural Validity

Based on modification indices (MI), modifications were performed to the original model to achieve better performance. Two cross-loadings were suggested by MI (Q2 and Q3 to emotional subscale) due to χ2 increasing by more than ten units. Notably, items Q2 and Q3, originally part of the Social subscale, were suggested to cross-load in the Emotional subscale. This modification aligns with the theoretical perspective, given that both items ("Felt concerned that your skin cancer may worry friends or family?" for Q2 and "Worried about the length of time before you can go out in public?" for Q3) could reasonably pertain to either the Emotional or Social subscale (Figure 1 and Table 4).

Criterion Validity

The Spearman correlations between the SCI-I subscales and their total score are displayed in Table 5. The values for the total score range from 0.59 to 0.933 indicating medium to very strong positive association. Notably, the correlation between the Appearance subscale and the total score is relatively lower, a phenomenon likely stemming from the limited

Table 4 Fit Results of the Competing Models Tested (n=100)

	Description	χ^2	Df	RMSEA (95% CI)	CFI	TLI	SRMR
Model 1	Original model (with three factors and 15 items)	163.598	87	0.094 (0.067, 0.12)	0.904	0.884	0.091
Model 2	Original model with one cross-loading item (Q3) as suggested by MI	152.566	86	0.088 (0.06, 0.115)	0.916	0.898	0.079
Model 3	Original model with two cross-loading items (Q3 and Q2) as suggested by MI	139.991	85	0.08 (0.05, 0.108)	0.931	0.915	0.064

Abbreviations: χ^2, chi squared; df, Degrees of freedom; RMSEA, Root Mean Square Error of Approximation; CI, Confidence Interval; CFI, Comparative Fit Index; TLI, Tucker Lewis Index; SRMR, Standardized Root Mean Squared Residual; Q3, 3rd question of Skin Cancer Index scale; MI, Modification indices; Q2, 2nd question of Skin Cancer Index scale.

Table 5 Correlations Between the SCI – I Subscales and the Total Score

	SCI – I Emotional	SCI – I Social	SCI – I Appearance	SCI – I Total
SCI – I Emotional	1			
SCI – I Social	0.578 ***	1		
SCI – I Appearance	0.374 ***	0.293 **	1	
SCI – I Total	0.933 ***	0.715 ***	0.59 ***	1

Notes: Significance: ** - p-value <0.01, *** - p-value <0.001.
Abbreviation: SCI – I, Skin Cancer Index scores at the 1st visit.

number of items in the Appearance subscale (3 out of 15). Nevertheless, the correlation coefficient for Emotional and Social subscales is highly significant and indicates medium coherence among these factors.

Construct Validity

Table 6 represents the Spearman correlation coefficients between the SCI-I and WHO-5-I. The results reveal a positive score correlation, ranging from very weak to weak. Highlighting the questionnaire's particular attention to social aspects, the strongest correlation was observed between the WHO-5-1, 2 and the Social subscale of the SCI-I.

Spearman correlations between SCI-I and DLQI-I values are displayed in Table 7. The analysis indicates that there is a negative correlation between SCI and DLQI, characterized as very weak to medium. The most significant negative correlation is found between DLQI4 and SCI Emotional and Social subscales. Notably, the DLQI shows the strongest correlation with the SCI Social subscale, underscoring the questionnaire's focus on social aspects.

The convergent construct validity is supported by the fact that 75% of the hypotheses were confirmed as true.

Measurement Error and Reliability

The test–retest reliability of the questionnaire resulted in an ICC of 0.83 (95% CI = 0.716–0.899) for the overall score (Table 8). All ICC values for Emotional, Social, and Appearance subscales are higher than 0.8, suggesting high consistency and reliability between different observers or measurement occasions.

The SEM for the overall score is 1.77 points, indicating a 68% probability that the true score for a patient falls within a range of −1.77 to +1.77 points relative to the observed score. With a 95% probability, this range expands to −3.54 to +3.54 points. For individual subscales, the SEM values range from 0.316 to 1.22, reflecting the precision with which the true scores of patients in these specific domains can be estimated based on their observed scores. The SDCind for the overall score is 4.906 points. This implies that an individual's overall quality of life score would need to change by at least 4.906 points before it could be confidently considered as a true change rather than a result of measurement error. Additionally, the SDCgroup value is established at 0.694 for the overall score, providing a benchmark for the minimum change that can be considered significant at a group level.

Table 6 Spearman Correlation Coefficients Between SCI – I and WHO-5-I Scores

	WHO-5-1	WHO-5-2	WHO-5-3	WHO-5-4	WHO-5-5	WHO-5 Total
SCI – I Emotional	0.231 *	0.312 **	0.216 *	0.278 **	0.023	0.292 **
SCI – I Social	0.353 ***	0.337 ***	0.293 **	0.21 *	0	0.333 ***
SCI – I Appearance	0.01	0.05	0.126	0.21 *	−0.01	0.12
SCI – I Total	0.261 **	0.33 ***	0.266 **	0.287 **	0.013	0.323 **

Notes: Significance: * - p-value <0.05, ** - p-value <0.01, *** - p-value <0.001.
Abbreviations: SCI – I, Skin Cancer Index scores at the 1st visit; WHO-5, The World Health Organization- Five Well-Being Index; WHO-5-1, 1st question of WHO-5; WHO-5-2, 2nd question of WHO-5; WHO-5-3, 3rd question of WHO-5; WHO-5-4, 4th question of WHO-5; WHO-5-5, 5th question of WHO-5.

Table 7 Spearman Correlation Coefficients Between SCI – I and DLQI Scores

	SCI – I Emotional	SCI – I Social	SCI – I Appearance	SCI – I Total
DLQI 1	−0.299 **	−0.318 **	−0.138	−0.311 **
DLQI 2	−0.207 *	−0.351 ***	−0.182	−0.256 *
DLQI 3	−0.19	−0.246 *	0.036	−0.174
DLQI 4	−0.343 ***	−0.394 ***	−0.036	−0.359 ***
DLQI 5	−0.208 *	−0.225 *	−0.021	−0.167
DLQI 6	−0.154	−0.178	−0.075	−0.152
DLQI 7	−0.014	−0.073	0.206 *	0.016
DLQI 8	−0.152	−0.225 *	−0.021	−0.14
DLQI 9	−0.167	−0.124	−0.018	−0.135
DLQI 10	−0.256 **	−0.115	−0.025	−0.238 *
DLQI Total	−0.355 ***	−0.478 ***	−0.072	−0.365 ***

Notes: Significance: * - p-value <0.05, ** - p-value <0.01, *** - p-value <0.001.
Abbreviation: SCI – I, Skin Cancer Index scores at the 1st visit; DLQI and the number represents the question of Dermatology Life Quality Index scale respectively.

Table 8 Test–Retest Reliability

	SCI – I Emotional	SCI – I Social	SCI – I Appearance	SCI – I Total
Test	30.16 ± 4.469	22.98 ± 2.308	13.42 ± 1.808	66.56 ± 7.251
Retest	30.08 ± 4.462	23.2 ± 2.148	13.26 ± 1.988	66.54 ± 7.279
ICC (95% CI)	0.81 (0.682; 0.886)	0.84 (0.737; 0.907)	0.88 (0.805; 0.932)	0.83 (0.716; 0.899)
MD (95% CI)	0.08 (−0.696; 0.856)	−0.22 (−0.566; 0.126)	0.16 (−0.093; 0.413)	0.02 (−1.170; 1.210)
SD_{dif}	2.798	1.25	0.912	4.293
SEM	1.22	0.5	0.316	1.77
SDC_{ind}	3.381	1.386	0.876	4.906
SDC_{group}	0.478	0.196	0.124	0.694
95% LoA	−5.404; 5.565	−2.67; 2.23	−1.627; 1.947	−8.394; 8.434

Abbreviations: SCI – I, Skin Cancer Index score during the 1st visit; ICC, Intraclass Correlation Coefficient; CI, Confidence Interval; MD, Mean difference score; SD_{dif}, Standard deviation of differences; SEM, Standard error of measurement; SDC_{ind}, Smallest detectable change in an Individual; SDC_{group}, Smallest detectable change in a group; LoA, Limits of agreement.

Sensitivity to Change and Responsiveness

The mean scores of SCI at 1st, 2nd and 3rd visits are presented Table 9.

The moderate to large responsiveness levels were observed for 1st vs 3rd as well as for 2nd vs 3rd visits, with the SRM values surpassing 0.5. It was detected that responsiveness fell into "low" category when analyzing the means of 1st vs 2nd visit (SRM <0.5).

Meaningful Changes Over Time

Statistically significant differences were observed in the SCI total and subscale scores across the 1st, 2nd, and 3rd visits (p<0.001). Notably, between the 1st and 3rd visits (p<0.001, mean difference +8.83 points), as well as between the 2nd and 3rd visits (p<0.001, mean difference +6.47 points). However, the only statistically significant difference between the 1st and 2nd visits was found to be in Emotional domain (p=0.044, mean difference +2.02) (Table 9 and Table 10).

Table 9 Mean SCI Scores at the 1st, 2nd and 3rd Visits

	SCI – I		SCI – II		SCI – III	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Emotional	25.66	6.27	27.68	5.55	30.55	4.28
Social	22.19	2.98	22.13	3.11	24.04	2.43
Appearance	12.36	2.86	12.60	2.53	14.24	1.69
Total	60.05	10.21	62.41	9.63	68.88	7.50

Abbreviations: SCI – I, Skin Cancer Index scores at the 1st visit; SCI – II, Skin Cancer Index scores at the 2nd visit; SCI – III, Skin Cancer Index scores at the 3rd visit; SD, Standard deviation.

Table 10 Standardized response mean (SRM)

		SRM value	95% CI	p
1st vs 2nd visit	SCI Total	0.22	0.04–0.37	0.22
	Emotional	0.40	0.20–0.57	0.04*
	Social	−0.02	−0.23–0.17	0.99
	Appearance	0.09	−0.12–0.30	0.80
1st vs 3rd visit	SCI Total	0.79	0.36–1.07	< 0.001***
	Emotional	0.81	0.47–1.04	< 0.001***
	Social	0.48	0.08–0.70	< 0.001***
	Appearance	0.62	0.29–0.79	< 0.001***
2nd vs 3rd visit	SCI Total	0.73	0.39–0.95	< 0.001***
	Emotional	0.58	0.34–0.77	< 0.001***
	Social	0.59	0.35–0.76	< 0.001***
	Appearance	0.71	0.40–0.89	< 0.001***

Notes: Significance values of post-hoc ANOVA tests: *p-value <0.05, ***p-value <0.001.
Abbreviation: SRM, Standardized response mean; CI, Confidence Interval.

The results indicate that there is significant improvement in Emotional domain 1 month after surgery compared to baseline scores. Furthermore, the statistically significant improvement in SCI Total and all subscale scores was detected 6 months after surgery, emphasizing the profound impact of the intervention.

Segment Analysis and SCI Score Differences Across Anatomic Units

To guarantee the feasibility of using statistical tests in the pilot phase, the analysis of score distributions across anatomical units excluded finer subunits due to the insufficient number of cases. Further division to subunits was reserved for descriptive statistics and future studies on this topic. Therefore, the mental unit comprising only one participant was excluded from the statistical analysis. The segment analysis with SCI score association to anatomic units at the 1st, 2nd, and 3rd visits is presented in Table 11, Tables 12 and 13.

SCI Differences Depending on Tumor Location

Across the anatomic units, there were no statistically significant differences observed in SCI Total/Emotional/Social/Appearance scores at 1st, 2nd, and 3rd visits.

Table 11 Segment Analysis and SCI Score Differences Across Anatomic Units at the 1st Visit

	SCI – I Emotional	SCI – I Social	SCI – I Appearance	SCI – I Total
Anatomic Unit	No, p = 0.65	No, p = 0.49	No, p = 0.36	No, p = 0.63 ES small
Gender	Yes, p < 0.05	Yes, p < 0.01	Yes, p < 0.001	Yes, p < 0.001
- Score differences between men and women by anatomic units	No	Yes, eyelid, p = 0.05	Yes, cheek p < 0.001	Yes, cheek, p < 0.05
Age	No, p = 0.70	No, p = 0.87	No, p = 0.06	No, p = 0.49
- Score differences between age groups by anatomic units	Yes, eyelid, p < 0.05	Yes, eyelid, p < 0.05	Yes, eyelid, p < 0.05	Yes, eyelid, p < 0.01
Surgery group (E, P, T)	Yes, p < 0.05	No, p = 0.29	No, p = 0.20	No, p = 0.06
- Score differences between surgery groups by anatomic units	No	Yes, cheek, p < 0.01	No	Yes, p < 0.05 cheek
Size group	No, p = 0.63	No, p = 0.25	No, p = 0.38	No, p = 0.21
- Score differences between size groups by anatomic units	No	No	No	No

Abbreviation: SCI – I, Skin Cancer Index scores at the 1st visit.

Table 12 Segment Analysis and SCI Score Differences Across Anatomic Units at the 2nd Visit

	SCI – II Emotional	SCI – II Social	SCI – II Appearance	SCI – II Total
Anatomic Unit	No, p = 0.98	No, p = 0.95	No, p = 0.52	No, p = 0.90
Gender	Yes, p < 0.05	No, p = 0.09	Yes, p < 0.01	Yes, p < 0.05
- Score differences between men and women by anatomic units	No	No	Yes, p < 0.001 cheek	Yes, cheek, p < 0.05
Age	No, p = 0.13	No, p = 0.05	Yes, p < 0.05	No, p = 0.10
- Score differences between age groups by anatomic units	Yes, upper lip, p < 0.05	Yes, nose, p < 0.05	No	No
Surgery group (E, P, T)	No, p = 0.73	No, p = 0.38	No, p = 0.87	No, p = 0.60
- Score differences between surgery groups by anatomic units	No	No	No	No
Size group	No, p = 0.07	No, p = 0.08	No, p = 0.18	Yes, p < 0.05
- Score differences between size groups by anatomic units	No	No	No	No

Abbreviation: SCI – II, Skin Cancer Index scores at the 2nd visit.

Table 13 Segment Analysis and SCI Score Differences Across Anatomic Units at the 3rd Visit

	SCI – III Emotional	SCI – III Social	SCI – III Appearance	SCI – III Total
Anatomic Unit	No, p = 0.89	No, p = 0.73	No, p = 0.30	No, p = 0.68
Gender	Yes, p < 0.01	No, p = 0.18	Yes, p < 0.01	Yes, p < 0.05
- Score differences between men and women by anatomic units	Yes, p < 0.01 nose	No	No	No
Age	No, p = 0.06	No, p = 0.33	No, p = 0.14	No, p = 0.09
- Score differences between age groups by anatomic units	No	No	No	No
Surgery group (E, P, T)	No, p = 0.31	No, p = 0.18	No, p = 0.50	No, p = 0.20
- Score differences between surgery groups by anatomic units	No	Yes, p < 0.05 eyelid	No	No
Size group	No, p = 0.27	No, p = 0.61	No, p = 0.29	No, p = 0.43
- Score differences between size groups by anatomic units	No	No	No	No

Abbreviation: SCI – III, Skin Cancer Index scores at the 3rd visit.

SCI Score Differences Between Men and Women

Noteworthy differences were detected in the SCI scores between men and women at all 3 time points, with the exception being SCI Social subscale at 2nd and 3rd visits. Men provided statistically significantly higher SCI scores, indicating better quality of life overall, especially in emotional and appearance aspects both pre- and post-interventionally.

Score Differences Between Men and Women by Anatomic Units

Upper lip unit group, consisting only of 1 woman participant was excluded from the analysis.

Considering the SCI score disparities between genders across anatomical units, three areas were found to exhibit statistically significant differences. Men showed higher SCI Total/Social/Appearance scores before surgery when their tumor was in either the cheek ($p<0.05$) or eyelid unit ($p<0.05$). This trend persisted post-surgery (visit 2nd), particularly in the cheek region ($p<0.05$). Six months after intervention, men with primary tumors in the nose unit evaluated their QoL in emotional domain statistically significantly better than women ($p<0.01$).

The anatomical tumor location did not appear to influence the scores between men and women on the SCI-I-Emotional, SCI II-Emotional/Social, and SCI III-Total/Social/Appearance subscales.

SCI Score Differences Between E, P, T Groups

The results indicate that significant differences between the SCI scores of E, P, and T groups were only found pre-interventionally. Patients in E group evaluated their QoL in emotional domain statistically significantly better than P group at 1st visit.

Score Differences Between Surgery Groups by Anatomic Units

T group in cheek unit, consisting only of 1 participant, was excluded from the analysis.

The findings suggest that the assessment of SCI by patients in different surgery groups varies significantly depending on tumor location. Particularly, the E group tends to evaluate the QoL in Social domain better compared to P group when the tumor is located on the cheek (1st visit) ($p<0.05$) and on the eyelid (3rd visit) ($p<0.05$).

SCI Score Differences Between Age Groups

Statistically significant differences between age groups were observed only in the SCI Appearance domain at the time of 2nd visit. Post hoc tests revealed that the 36–56 y group rated SCI Appearance subscale statistically significantly worse compared to 57–69 y group ($p<0.05$).

Score Differences Between Age Groups by Anatomic Units

The results revealed three sensitive areas: the eyelid during the initial visit, and the upper lip and nose during the 2nd visit. These differences are reflected in both total and subscale scores. Notably, following intervention, the areas of age-related concern shift, with prominent disparities observed in SCI Emotional scores for the upper lip region and SCI Social scores for the nose region at the 2nd visit. Interestingly, the SCI-II-Appearance and SCI-III did not reveal any significantly different anatomic areas of concern between age groups.

Post hoc tests to identify differing pairs were not feasible due to the 70–79 y group, comprising only 1 participant in the eyelid unit – when this group was removed, p-value according to ANOVA was no longer statistically significant.

SCI Score Differences Between Tumors Size Groups

The results indicate that significant differences between the SCI Total scores by tumor size groups were only found post-interventionally at the 2nd visit. Patients with tumors ranging from 6 to 10 mm exhibited generally higher SCI Total scores compared to those with tumors measuring 11–15 mm ($p<0.05$).

Score Differences Between Size Groups by Anatomic Units

Across the anatomic units, there were no statistically significant differences observed in SCI Total/Emotional/Social/Appearance scores at the 1st, 2nd, and 3rd visits between patients in different tumor size groups ($p>0.05$).

Discussion

In this study, the SCI was translated and culturally adapted to suit the Lithuanian patient population with facial NMSC. Following the rigorous methodology for PROM validation, an extensive investigation into various psychometric properties of the scale was conducted. The findings revealed that all assessed parameters, including internal consistency, structural validity, criterion validity, construct validity, discriminative convergent validity, sensitivity to change, responsiveness, measurement error, and reliability, surpassed acceptable thresholds. Our statistical analysis of the factorial structure corresponds to the model initially proposed by Rhee et al,[22] and subsequently confirmed by Samela et al,[25] validating the existence of three factors corresponding to Emotional, Social, and Appearance subscales. In contrast, the Spanish[23] and Melanoma-SCI[34] versions demonstrated a two-factor structure. Two cross-loadings were included for items Q2 and Q3, revealing their interchangeability in both Emotional and Social subscales. Similar phenomenon regarding these two subscales was identified during the validation process in the Italian language. However, the Italian study found cross-loadings in the items Q5 and Q9.[25]

Our study had a higher ratio of women to men compared to established literature, likely due to our methodology of including every consecutive patient meeting the inclusion criteria. The gender-specific behaviors and longer women's life expectancy could have led to an older average age among our participants. While this gender imbalance might have influenced the results, we believe our consecutive inclusion methodology minimizes potential selection bias. Therefore, the atypical gender distribution in our sample likely reflects the specific patient population at our center during the study period and the natural demographic variations in BCC incidence among older populations.

Primary differences of SCI scores were evaluated considering factors such as gender, age, tumor size, location, and surgery type. Sensitive groups throughout all 3 visits were identified.

Gender differences were evident, with men reporting higher overall SCI scores compared to women at all time points. This disparity was particularly notable in the emotional and appearance domains. These findings suggest that women may experience greater psychological and aesthetic distress related to facial BCC and its treatment. Clinicians should consider these gender differences when planning and providing post-operative care and support.

Age and tumor size were additional factors of QoL. Significant differences in the appearance domain were observed between age groups post-surgery, particularly between the 36 to 56 years group and the 57 to 69 years group. Patients with smaller tumors (6–10 mm) reported higher QoL than those with larger tumors (11–15 mm) at the second visit.

The segment analysis revealed notable variations in QoL of patients with tumors in various locations for different patient groups. Tumors in aesthetically sensitive areas such as the cheek, nose, and eyelid were associated with lower QoL scores both pre- and post-surgery. Although post hoc tests were mostly not feasible given the relatively small sample size, the identification of significant differences laid the groundwork for future studies. This highlights the importance of surgical precision and aesthetic considerations in these regions to minimize the impact on patients' QoL.

The type of surgery performed also influenced QoL outcomes. Patients undergoing primary excision reported better emotional domain scores compared to those undergoing skin plasty pre-surgery. However, post-surgery, the differences between these groups were not statistically significant, suggesting that the initial psychological impact of more extensive surgeries may diminish over time. This finding indicates that while less invasive surgeries may offer immediate emotional benefits, all surgical treatments eventually contribute to improved QoL. This observation suggests that following the intervention, the appearance of the scar could be a more significant factor over the extent of the surgery performed. Interestingly, this hypothesis does not manifest in the scores of the Appearance domain, which exhibited no significant differences among patients with varying tumor sizes or locations.

Our findings highlight the great impact of surgery on the QoL of patients with facial NMSC. However, in contrast to previous findings,[12] we observed that the most significant improvement in QoL following the intervention is apparent during later follow-up visits rather than within the first month post-surgery. Specifically, one month after surgery, the improvements tend to be present only in the emotional aspect of patients' lives.

Strengths

The notable strengths of this study lie within its prospective longitudinal design, focusing exclusively on patients with facial BCC. By including each participant consecutively, we avoided selection bias, which enhanced the credibility and relevance of our findings. The use of multiple validated instruments, including SCI, DLQI, and WHO-5, offers a comprehensive evaluation of both immediate and longer-term QoL from different perspectives enhancing the reliability and depth of the findings.

Furthermore, the study identified significant determinants of QoL, including gender, tumor location, and size. These findings are highly relevant for clinical practice worldwide, as they can guide the development of personalized treatment plans aimed at optimizing patient outcomes. The emphasis on tumors in aesthetically sensitive areas provides valuable insights into the psychological and emotional impacts of BCC, which are critical for improving patient care and support globally.

Additionally, the inclusion of a culturally adapted and validated Lithuanian version of the SCI ensures that the findings are grounded in the specific context of the patient population, which enhances the study's relevance and applicability.

Limitations

While this study offers valuable insights, it has a few key limitations that should be noted. As a pilot study with a sample size of 100 patients, the findings may not be fully generalizable to all populations. Larger multi-center studies are needed to confirm these results and extend their applicability.

While we captured the QoL during the critical clinical period, a longer follow-up could offer further insights. Finally, the cultural adaptation of the SCI to Lithuanian patients, while essential, may limit the direct applicability of the findings to other cultural contexts.

These limitations highlight areas for further research to confirm and expand upon the study's findings, ensuring their relevance and applicability in diverse clinical settings. Future research should balance validation efforts with a more extensive examination of clinical outcomes.

Conclusions

The Lithuanian version of the SCI can be confidently used in clinical practice and research settings to assess the impact of skin cancer on patients' well-being, with three subscales offering detailed insights into emotional, social, and appearance-related distress.

Surgical NMSC treatment significantly improves QoL, with the most substantial impact being observed 6 months after surgery. Key determinants of QoL include gender, tumor location, and tumor size. Men, patients with smaller tumors, and those with tumors outside of aesthetically sensitive areas reported better QoL outcomes. Meanwhile, women, patients undergoing skin plasty and those with tumors located in aesthetically sensitive regions such as the cheek, nose, and eyelid presented with lower QoL.

These findings highlight the critical importance of early diagnosis, less invasive treatments, and tailored post-operative care in enhancing patient well-being. Further studies are needed to explore the multifactorial influences of sociodemographic, clinical, anthropometric, and scar-related variables on HRQoL in a bigger sample size.

Data Sharing Statement

The data underlying this article will be shared by the corresponding author upon reasonable request.

Ethics Statement

The approval to conduct the study was issued by The Vilnius Regional Biomedical Research Ethics Committee, Approval No. 2022/11-1476-943. In alignment with the Declaration of Helsinki, all study participants provided written informed consent.

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