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RHINOLOGY

Cross-cultural adaptation and validation of the SNOT-22 into Italian

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Abstract The aim of this study is to evaluate the reliability and validity of the Italian SNOT-22 (I-SNOT-22). The study consisted of five phases: item generation, reliability analysis, normative data generation, validity analysis and responsiveness analysis. The item generation phase followed the five-step, cross-cultural, adaptation process of translation and back-translation. A group of 222 patients with chronic rhinosinusitis (CRS) were enrolled for the internal consistency analysis. Sixty patients completed the I-SNOT-22 twice, 2 weeks apart, for test–retest reliability analysis. A group of 119 asymptomatic subjects completed the I-SNOT-22 for normative data generation. I-SNOT-22 scores obtained by CRS patients and asymptomatic subjects were compared for validity analysis. I-SNOT-22 scores were correlated with Lund-Mackay and visual analogue scale (VAS) scores in 50 CRS patients for criterion validity analysis. Finally, I-SNOT-22 scores obtained in a group of 59 CRS patients before and after surgical treatment for CRS were compared for responsiveness analysis. All the enrolled subjects managed to complete the I-SNOT-22 without needing any assistance. Internal consistency was satisfactory ($\alpha = 0.86$). Test–retest reliability was also satisfactory (ICC = 0.85). A significant difference in the I-SNOT-22 scores between the CRS patients and the asymptomatic subjects was found ($p < 0.008$). Positive significant correlations were found between I-SNOT-22 and VAS scores, while no significant correlations were found between I-SNOT-22 scores and Lund–Mackay scores. I-SNOT-22 scores obtained in the pre-treatment condition were significantly higher than those obtained after surgery. I-SNOT-22 is reliable, valid, responsive to changes in QOL, and recommended for clinical practice and outcome research.

Keywords Chronic rhinosinusitis · Quality of life · Self-assessment

Introduction

Health is a multidimensional concept, incorporating physical, mental and social state of being [1]. For this reason, the evaluation of a patient has moved from a traditional assessment, related only to physical well-being, to a more holistic approach that includes quality of life (QOL) measures. The latter focus on the impact any given health status might have on QOL; they may influence treatment planning and may be used as outcome measures. This is particularly useful in the assessment of patients affected by chronic rhinosinusitis (CRS), with or without nasal polyps, since it has a profound influence on the QOL of the people suffering from it because of nasal obstruction, impaired olfaction, fatigue, social dysfunction or emotional manifestations [2]. Such impact has been proven using global measures of QOL such as the SF-36 [3, 4]. However, generic instruments may not be capable to factor the effects of interventions and treatment [5]. Also, neither objective measures, nor videoendoscopic or radiological ratings can measure the level of handicap that a person perceives as a

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result of CRS; thus, patient-based, rhinologic-specific outcomes measures can potentially provide additional information to biological and physiological variables and impact on treatment planning.

In rhinological practice, several questionnaires are available [6]. Morley and Sharp [7] compared 15 QOL questionnaires and concluded that the Sinonasal Outcome Test-22 (SNOT-22) was the most appropriate for the evaluation of patients with CRS. The latter is a simple and fast questionnaire structurally composed of 22 CRS-related items which evaluate the severity of complaints that the patient has been experiencing over the past weeks. SNOT-22 is a modification of SNOT-20, adding to the latter two specific rhinological symptoms: (a) nasal obstruction and (b) loss of sense of taste and smell [2]. All items are scored from 0 to 5. The sum of each item results in a maximum score of 110. High score indicates poor outcome. The questions composing the SNOT-22 can be divided into two categories: questions about physical symptoms (12 questions) which cover rhinologic symptom as well as ear and facial symptom, and questions about health and QOL (10 questions) which cover sleep function and psychological issues [8].

The SNOT-22 has been adapted and validated in several languages [5, 6, 8–16], has been used in different outcome researches and is gaining popularity in an increasingly diverse range of rhinological conditions and interventions, for example septoplasty and septorhinoplasty [17, 18]. The questionnaire has demonstrated good internal consistency and adequate reliability thus suggesting that the SNOT-22 could be a useful tool to assess the impact of CRS on the patient's QOL as well as for outcomes research in rhinology [7].

The aim of this study was (1) to culturally adapt into Italian the SNOT-22, (2) to evaluate its internal consistency and reliability, (3) to evaluate its validity and responsiveness. The underling hypothesis are: (1) the SNOT-22 can be culturally adapted into Italian; (2) the Italian version of the SNOT-22 presents strong internal consistency and reliability; (3) the validity and responsiveness of the Italian version of the SNOT-22 are strong.

The importance of this study lies in the fact that a validated SNOT-22 for Italian language will improve its applications in Italian patients with CRS, allowing a deeper knowledge of their QOL related to nasal impairment, adding important information for the clinician, and facilitating both the diagnostic work-up and the decision-making process on treatment options. Besides, an Italian version of the SNOT-22 will allow the accomplishment of national, cross-cultural and cross-country studies.

Method

The study consisted of five different phases: item generation (phase 1), internal consistency and reliability analysis (phase 2), normative data generation (phase 3), validity analysis (phase 4) and responsiveness analysis (phase 5). The COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN) checklist was followed for the different phases [19].

The study was carried out according to the Declaration of Helsinki and it was previously approved by the Institutional Review Boards of the hospitals where the study was performed.

Participants

Different groups of patients were recruited for each of the five different phases of the study (Table 1). All subjects enrolled in the study gave their written informed consent. Only patients with normal cognitive function (mini mental state examination score >24 for subjects older than 65) and those with preserved reading skills were included in the study. Data for phases 2, 3, 4 and 5 were gained from different rhinologic centers in Italy to ensure applicability of the SNOT-22 in different settings. All data were collected prospectively.

Phase 1: I-SNOT-22 generation

Cross-cultural adaptation of the SNOT-22 was performed using standard techniques [20]. Items of the original questionnaire were translated into Italian by one professional translator and one bilingual investigator (step 1: forward translation). Two independent otolaryngologists, familiar with the process of instrument validation, examined semantic, idiomatic and conceptual issues and further refined these versions. A final consensus version was obtained (step 2 of 5: synthesis) and given to two professional translators to produce literal translation into English (step 3 of 5: back-translation). Once this task was completed, the two translators and an expert committee reviewed all reports to produce a pre-final version of the instrument (step 4 of 5: expert committee review). Thirty patients, 15 females and 15 males, affected by CRS were enrolled in a pilot study (step 5 of 5: pretesting). CRS diagnosis was defined, accordingly to the "European Position Paper on Rhinosinusitis and Nasal Polyps 2012", as an inflammation of the nose and paranasal sinuses characterized by 2 or more symptoms, one of which should be either nasal blockage, obstruction/congestion or nasal discharge, ±facial pain/pressure ±reduction/loss of smell. One endoscopic finding (nasal polyps, mucopurulent

Table 1 Clinical and demographic characteristics of the samples

Phase of the study		Type of study	Sample clinical characteristics	Age	Sex	
					M	F
1	Item generation	Item generation	Patients with CRS ($n = 30$)	52 (26–74)	15	15
2	Internal consistency	Internal consistency	Patients with CRS ($n = 222$)	55 (22–79)	117	105
	Reliability analysis	Test–retest reliability	Patients with CRS ($n = 60$)	49 (27–79)	33	27
3	Normative data generation	Normative data	Asymptomatic subjects ($n = 119$)	53 (18–75)	59	60
4	Validity analysis	Construct validity	Asymptomatic subjects ($n = 119$)	53 (18–75)	59	60
		Criterion validity (correlation between I-SNOT-22 scores and VAS and Lund–Mackay scores)	Patients with CRS ($n = 222$)	55 (22–79)	117	105
			Patients with CRS ($n = 50$)	51 (29–78)	29	21
5	Responsiveness analysis	Comparison pre- and post-surgical treatment	Patients with CRS ($n = 59$)	57 (31–76)	33	26

Age is reported as mean (range)

discharge) and/or findings on computed tomography (mucosal changes within the ostiomeatal complex and/or sinus) should be present. Symptoms should last for more than 12 weeks [21].

Each patient autonomously filled out this version of the SNOT-22 and discussed the wording and meaning of each item with the senior clinician. The wordings of the questionnaire were modified on the basis of the suggestions given by the patients and this led to the final version of the Italian SNOT-22 (I-SNOT-22).

Phase 2: reproducibility of I-SNOT-22

The aim of the second phase of the study was to evaluate the reproducibility of the I-SNOT-22. The latter was assessed using two methods: internal consistency and test–retest reliability. Clinical data were obtained from 222 consecutive patients (117 men and 110 women) consulting for CRS. Median age of the participants was 55 years (range 22–79). Inclusion criteria were: age older than 18 years, CRS diagnosed based on "European Position Paper on Rhinosinusitis and Nasal Polyps 2012" [21]. Exclusion criteria were sinonasal malignancy, radiation therapy to the head and neck, previous surgery of the nose (including sinus surgery, septoplasty, rhinoplasty, turbinoplasty), septal perforation, cranio-facial syndrome, acute nasal trauma or fracture in the past 3 months, nasal valve collapse, adenoid hypertrophy, sarcoidosis, Wegener's granulomatosis, uncontrolled asthma, pregnancy, and illiteracy [22]. Each patient autonomously filled out the I-SNOT-22 during a clinic visit.

Internal consistency assesses the extent to which each item in a factor measures the same underlying construct. Cronbach's alpha estimates between 0.7 and 0.9 were taken to indicate acceptable internal consistency [23]. For this analysis, the I-SNOT-22 scores obtained in the group of 222 patients were used. The I-SNOT-22 scores obtained in this group of patients were also used for clinical validity analysis in phase 4 of the study.

Sixty patients out the 222 patients affected by CRS were randomly selected for test–retest reproducibility analysis. For this purpose, the I-SNOT-22 was administered twice, approximately 2 weeks spaced out. This interval period was selected because no substantial change was expected to take place in subjects' nasal condition within this period. While completing the second I-SNOT-22, subjects did not have any chance to check over their responses from the first questionnaire. Test–retest reliability was assessed through Spearman's test and ICC, both for total score and for scores of single questions included in I-SNOT-22. A minimum test–retest correlation coefficient of 0.7 was considered acceptable.

Phase 3: Normative data generation

The aim of the third phase of the study was to establish the baseline distribution for I-SNOT-22 scores by collecting data from a wide, randomly selected, representative sample of subjects with no history nor symptoms of CRS, and with no disease leading to sinonasal disorders.

For this reason, a group of 119 control subjects, 59 males and 60 females, with a median age of 53 years (range 18–75) and with no past medical history of nasal, voice, swallowing, reflux, airway, neurologic, rheumatologic, hematologic or neoplastic disorders were enrolled. The cohort included hospital personnel, medical and nursing students, and visitors to the medical center or patient's companions who agreed to participate in the study. Each subject managed to complete the I-SNOT-22 without any help and underwent nasal endoscopy in order to exclude CRS. The data obtained from this group of patients were also used for clinical validity analysis in phase 4 of the study.

Phase 4: validity

The aim of the fourth phase of the study was to assess the degree to which the I-SNOT-22 measures the construct it purports to measure (validity) [24]. Construct validity is the degree to which I-SNOT-22 scores are consistent with the hypotheses. To analyse construct validity, the I-SNOT-22 scores of the 222 patients affected by CRS recruited for internal consistency analysis were compared with the normative data obtained from asymptomatic individuals ($n = 119$).

Criterion validity is the degree to which I-SNOT-22 scores are an adequate reflection of a gold standard. To analyse criterion validity, a different group of 50 patients with CRS (29 males and 21 females with a mean age of 51 years) were enrolled. Each patient managed to complete, autonomously, the I-SNOT-22 and a visual analogue scale (VAS) assessing the severity of his/her disease. A 100-mm line with the extremes "worst condition possible" (100 mm) and "no symptoms" (0 mm) was used. Also, each CT scan of the enrolled patients was scored according to the Lund–Mackay scale.

Phase 5: responsiveness

Responsiveness refers to the ability of the questionnaire to detect important changes over time in the construct to be measured. To assess the responsiveness of I-SNOT-22, a novel cohort of 59 patients affected by CRS and who were surgically treated following the guidelines of EPOS 2012 [21] were recruited. Each patient completed the I-SNOT-22 before and 3 months after the surgical procedure. All the surgical procedures were performed by a single surgeon. The surgeon was blind to I-SNOT-22 scores, to ensure stability and accuracy of the data. The I-SNOT-22 scores obtained in the pre-treatment condition were compared with those obtained in the post-treatment condition. Also, to define a clinically relevant (difference) score for purposes of group comparisons, Cohen's effect sizes (ES) were calculated for each of the subscales of the I-SNOT-22 as well as for its total score. By convention, an effect magnitude between 0.2 and 0.5 is considered a mild improvement; between 0.5 and 0.8—moderate improvement; and greater than 0.8—a great improvement in the quality of life [9].

Statistical analysis

Statistical tests were performed using SPSS 19.0 statistical software (SPSS, Inc., Chicago, IL, USA). Internal consistency was assessed using Cronbach's alpha coefficient. Spearman correlation test and ICC were used to evaluate test–retest reliability of I-SNOT-22 by comparing the baseline and retesting responses. Comparison of I-SNOT-22 scores in CRS patients and in the control group was assessed using Student's t test. The correlations between I-SNOT-22 scores and VAS and Lund–Mackay results were assessed using Spearman's test. The distributions of I-SNOT-22 scores obtained in pre- and post-treatment assessment were compared using Wilcoxon's test. The effect size was calculated as the difference between the pre-treatment group mean minus the post-treatment group mean, divided by the standard deviation of the initial values. For all statistical comparisons, an $\alpha = 0.05$ and a power of 0.80 were used.

Results

All of the patients and control subjects included in the study managed to fully complete, autonomously, the I-SNOT-22 without any need of assistance. The time required to fulfil the questionnaire never exceeded 10 min.

Internal consistency and reliability analysis

Internal consistency scores are reported in Table 2; Cronbach's alpha scores were satisfactory for the I-SNOT-22 total score as well as for its two subscales, ranging from $\alpha = 0.82$ for the physical symptoms subscale to $\alpha = 0.87$ for the heath and QOL subscale.

ICC and Spearman correlation scores for the 60 patients recruited for test–retest reliability analysis of the I-SNOT-22 scores are reported in Table 2. Test–retest reliability was satisfactory for all the items, ranging from $r = 0.71$ for Item 17 to $r = 0.93$ for item 4.

Normative data

The mean age of asymptomatic subjects ($n = 119$) was 53 years (18–75). Males accounted for 49.6 %. The mean I-SNOT-22 score for the normal cohort was 14.3 ± 8.6 (0–33). The mean-plus-2 standard deviation yielded an upper limit of normal for the I-SNOT-22 score of 31.5.

Clinical validity analysis

The mean scores obtained from patients and from asymptomatic subjects are reported in Table 3. These data show consistently lower values of I-SNOT-22 for asymptomatic subjects on Student's t test analysis ($p = 0.008$).

The correlation between I-SNOT-22, VAS and Lund–Mackay scores obtained in a group of 50 patients with CRS was analysed for criterion validity. Positive significant correlations were found between I-SNOT-22 and VAS scores (see Table 4) on Spearman's test. In particular, the

Table 2 Test–retest reliability ($n = 60$) and internal consistency ($n = 222$) of the I-SNOT-22

I-SNOT-22	Item	ICC ($n = 60$)	Spearman's test ($n = 60$)	Internal consistency ($n = 222$)
Physical symptoms	1	0.87 (0.82–0.91)	$r = 0.86$	
	2	0.92 (0.87–0.94)	$r = 0.92$	
	3	0.85 (0.78–0.90)	$r = 0.85$	
	4	0.93 (0.84–0.97)	$r = 0.93$	
	5	0.83 (0.74–0.86)	$r = 0.84$	
	6	0.81 (0.76–0.83)	$r = 0.82$	
	7	0.87 (0.82–0.92)	$r = 0.86$	
	8	0.80 (0.76–0.87)	$r = 0.80$	
	9	0.78 (0.73–0.81)	$r = 0.79$	
	10	0.85 (0.75–0.87)	$r = 0.85$	
	11	0.87 (0.79–0.92)	$r = 0.86$	
	12	0.77 (0.72–0.83)	$r = 0.78$	
	Total	0.87 (0.81–0.93)	$r = 0.87$	$\alpha = 0.82$
Health and QOL	13	0.90 (0.83–0.94)	$r = 0.91$	
	14	0.92 (0.88–0.96)	$r = 0.92$	
	15	0.88 (0.81–0.96)	$r = 0.88$	
	16	0.84 (0.76–0.89)	$r = 0.85$	
	17	0.71 (0.65–0.75)	$r = 0.71$	
	18	0.74 (0.68–0.80)	$r = 0.75$	
	19	0.79 (0.76–0.87)	$r = 0.80$	
	20	0.85 (0.81–0.90)	$r = 0.86$	
	21	0.83 (0.78–0.87)	$r = 0.84$	
	22	0.91 (0.88–0.93)	$r = 0.92$	
	Total	0.84 (0.78–0.88)	$r = 0.84$	$\alpha = 0.87$
Total		0.85 (0.79–0.91)	$r = 0.85$	$\alpha = 0.86$

The results of test–retest reliability of the single items, the two subscales of the questionnaire and the I-SNOT-22 total score are reported. The internal consistency analysis was performed for I-SNOT-22 total score as well as for the physical symptoms and the health and QOL subscales of the questionnaire

Table 3 Mean ± standard deviation of the I-SNOT-22 scores in CRS patients and in control subjects

I-SNOT-22	Normal subjects ($n = 119$)	CRS patients ($n = 222$)	p score
Physical symptoms	7.1 ± 4.6 (0–17)	27.5 ± 10.9 (5–60)	0.001
Health and QOL	7.3 ± 5.4 (0–21)	18.3 ± 12.2 (0–50)	0.001
Total	14.3 ± 7.4 (0–29)	48.9 ± 23.2 (13–110)	0.008

Ranges are reported in brackets. The results of Student's t test comparison are also reported

highest correlation was found between the I-SNOT-22 physical symptoms subscale scores and the VAS scores ($r = 0.54$). No significant correlations were found between I-SNOT-22 scores and Lund–Mackay scores on Spearman's test.

Phase 5: responsiveness

I-SNOT-22 scores obtained by a group of 59 patients affected by CRS and who were surgically treated following the guidelines of EPOS 2012 [21], were compared for

Table 4 Results of Spearman's correlation test between I-SNOT-22 scores and VAS and Lund–Mackey scores on a group of 50 patients with CRS

	VAS	Lund–Mackay
I-SNOT-22		
Physical symptoms	0.54*	0.28
Health and QOL	0.38*	0.21
Total	0.42*	0.27

* Statistically significant ($p = 0.05$)

Table 5 Mean ± standard deviation of the I-SNOT-22 scores in the pre- and post-treatment condition of CRS patients ($n = 59$)

I-SNOT-22	CRS patients pre-therapy	CRS patients post-therapy	p score	Cohen's d
Physical symptoms	26.1 ± 9.9 (7–60)	11.4 ± 12.6 (5–41)	0.001	1.485
Health and QOL	18.2 ± 11.3 (5–50)	8.6 ± 11.7 (5–48)	0.001	0.850
Total	44.4 ± 22.7 (17–110)	20.1 ± 23.8 (13–100)	0.001	1.070

Range are reported in brackets. The results of Wilcoxon test are also reported as well as those of Cohen's effect size

Table 6 Comparison among data of different SNOT-22 translation studies

Study	Internal consistency	Test–retest	Validity	Responsiveness	Mean score	
					CRS	Control
Hopkins et al. [2] (English)	0.91	0.93	<0.0001	<0.0001	42.0	9.3
Caminha et al. [5] (Brazilian Portuguese)	0.88	0.91	NT	NT	NT	NT
Lachanas et al. [6] (Greek)	0.84	0.91	<0.0001	<0.0001	49.6	13.0
Galitz et al. [8] (Hebrew)	0.94	0.88	<0.0001	<0.001	50.4	13.2
Vaitkus et al. [9] (Lithuanian)	0.89	0.72	<0.0001	<0.0001	52.4	16.8
De Dorlodot et al. [10] (French)	0.93	0.78	<0.0001	<0.0001	41.0	8.3
De los Santos [11] (Spanish)	0.91	0.87	<0.0001	<0.0001	47.2	4.5
Schalek et al. [12] (Czech)	0.86–0.90	0.86	V	V	38.5	10.2–13.7
Kosugi et al. [13] (Brazilian Portoguese)	0.88	0.91	<0.0001	<0.0001	62.39	11.4
Lange et al. [14] (Danish)	0.83	0.70	NT	NT	29.7	NT
Mozzanica et al. (Italian)	0.86	0.85	0.008	0.001	48.9	14.3

The results of internal consistency (assessed through Cronbach's alpha coefficient), test–retest reliability (assessed through Spearman's coefficient, ICC or Pearson's coefficient), known-group validity (assessed through Student's t test or Mann–Whitney test) and responsiveness (assessed through Student's t test or Mann–Whitney test) are reported

V tests reported as statistically significant without mention of p value, *CRS* chronic rhinosinusitis, *NT* not tested

responsiveness analysis. I-SNOT-22 scores obtained in the pre-treatment condition were significantly higher than those obtained after the surgical treatment ($p = 0.001$) (Table 5). ES results are reported in Table 5, showing a significant effect size for the two I-SNOT-22 subscale scores as well as for the I-SNOT-22 total score.

Discussion

The SNOT-22 is a health-related QOL assessment tool, first developed by Hopkins et al. [2], and then adopted, using a standardized method, into different cultural and linguistic contexts [5, 6, 8–16]. Also in the present study, the five-step procedure suggested by Beaton et al. [24] was followed. This method ensures equivalence to the original questionnaire and allows the comparability of responses across populations divided by language or culture.

In the present study, the psychometric properties of the Italian version of the I-SNOT-22 were studied. The results showed good internal consistency, test–retest reliability and good clinical validity and responsiveness. These results further support the application of the I-SNOT-22 scale as a reliable tool for QOL assessment in patients affected by CRS.

Specific findings related to the I-SNOT-22 are noteworthy. In particular, all of the subjects completed the questionnaires, suggesting that they understood the whole of the questions and were comfortable answering them. Consequently, it might be speculated that the I-SNOT-22 is not a burdensome instrument and is easily self-administered. The I-SNOT-22 internal consistency appeared good with an overall Cronbach's α coefficient value of 0.86 in 222 patients. These results are similar to those previously reported (Table 6). In particular, the overall Cronbach's α coefficients ranged from 0.83 in the study by Lange et al. [14] to 0.94 in the study by Galitz et al. [10].

As far as the reliability of the I-SNOT-22 is concerned, the scores obtained in the test–retest analysis support the idea that the I-SNOT-22 has a high stability and reproducibility over time. In fact, the Spearman's and ICC correlation scores for the I-SNOT-22 total score were both 0.85, a value which can be considered satisfactory. Also in previous studies, the reliability of the questionnaire was considered satisfactory, ranging from 0.70 [14] to 0.93 [2].

Concerning the normative data, the group of Italian asymptomatic subjects scored 14.3 ± 8.6. These data appear higher than those found in the original study of Hopkins et al. [2], who reported a mean SNOT-22 score of 9.3 in the control group. Also, de Dorlodot et al. [10], Kosugi et al. [13], and De los Santos et al. [11], reported a mean SNOT-22 score lower than those found in the present study (8.3, 11.4 and 4.5, respectively). On the other hand, the mean scores for the control groups reported in other studies [6, 8, 9, 12] appear more similar to those reported in the present one. These differences might be related to a number of factors, including the demographic characteristics of the enrolled asymptomatic populations. The mean age of the Italian control group (53 years) was older as compared with those reported by de Dorlodot et al. [10], Kosugi et al. [13], and De los Santos et al. [11] (45.2, 23.4, and 41 years, respectively). Also, the control group enrolled in the study of Hopkins et al. [2] comprised members of a local indoor tennis club, which, as physically active people, might have had fewer general health complaints [9].

CRS patients scored significantly higher values of I-SNOT-22 than healthy subjects. These findings are in agreement with previous reports. In the original study, Hopkins et al. [2] demonstrated excellent between-group discrimination. It is possible to speculate that I-SNOT-22 may be a sensitive tool to identify CRS patients. Moreover, the significant difference between I-SNOT-22 scores before and after surgical treatment for CRS suggests that I-SNOT-22 may be useful also in monitoring the treatment response. In particular, the magnitude of the effect of the surgery after 3 months was 1.070, and was considered to be high [9]. Also, Hopkins et al. [2] reported similar results, while Kosugi et al. [13] and Vaitkus et al. [9] found that the magnitude of the effect of surgery was higher (1.57 points, and 1.48 points, respectively). It is possible that these differences could be related to the pre-treatment SNOT-22 scores. In the study of Hopkins et al. [2], the mean pre-treatment SNOT-22 score was 41.7 ± 19.7. In the present study, the mean pre-treatment I-SNOT-22 score was 44.4 ± 22.7, while in the studies of Kosugi et al. [13] and Vaitkus et al. [9], the mean pre-treatment SNOT-22 scores were higher (52.43 ± 20.2 and 62.39 ± 25.30, respectively). The mean post-treatment SNOT-22 scores were almost the same in these four studies, thus suggesting that the differences in the magnitude of the effect of surgery might be related to more severe complaints of CRS patients in Kosugi et al.'s [13] and Vaitkus et al.'s [9] studies.

Examining the correlations between the I-SNOT-22 and the VAS, the results here reported appear similar to those reported by de Dorlodot et al. [10], further supporting the criterion validity of the I-SNOT-22. Similar to previous reports [10, 25], also in the present study, no significant correlations between I-SNOT-22 scores and Lund–Mackay scores were found.

In conclusion, the current findings support the reliability and validity of the I-SNOT-22 questionnaire for the assessment of QOL in Italian adult patients affected by CRS. The application of I-SNOT-22 in everyday clinical practice as well as in epidemiological, efficacy and outcome research is then recommended since it could facilitate the comparison of results of different studies.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

References

1. World Health Organization (1971) The economics of health and disease. WHO Chronicles 25:20–24
2. Hopkins C, Gillett S, Slack R et al (2009) Psychometric validity of the 22-item sinonasal outcome test. Clin Otolaryngol 34:447–454
3. Ware jr JE, Sherbourme CD (1992) The MOS 36-item short form health survey (SF-36). I. Conceptual framework and item selection. Med Care 30:473–483
4. Gliklich RE, Metson R (1995) The health impact of chronic sinusitis in patients seeking otolaryngologic care. Otolaryngol Head Neck Surg 113:104–109
5. Caminha GP, de Melo JT, Hopkins C, Pizzichini E, Menezes Pizzichini MM (2012) SNOT-22 psychometric properties and cross-cultural adaptation into Portuguese language spoken in Brazil. Braz J Otorhinolatyngol 78:34–39
6. Lachanas VA, Tsea M, Tsiouvaka S, Hajiioannou JK, Skoulakis CA, Bizakis JG (2014) The sino-nasal outcome test (SNOT)-22: validation for Greek patients. Eur Arch Otorhinolaryngol 217:2723–2728
7. Morley AD, Sharp HR (2006) A review of sinonasal outcome scoring systems: which is best? Clin Otolaryngol 31:103–109
8. Galitz YS, Halperin D, Bavnik Y, Warman M (2016) Sino-Nasal Outcome test-22: translation, cross-cultural adaptation and validation in Hebrew-speaking patients. Otolaryngol Head Neck Surg **(In press)**
9. Vaitkus S, Padervinskis E, Balsevicius T et al (2013) Translation, cross-cultural adaptation, and validation of the sino-nasal outcome test (SNOT)-22 for Lithuanian patients. Eur Arch Otorhinolaryngol 270:1843–1848
10. De Dorlodot C, Horoi M, Lefebvre P, Collet S, Bertrand B, Eloy P, Poirrier AL (2014) French adaptation and validation of the sino-nasal outcome test-22: a prospective cohort study on quality of life among 422 subjects. Clin Otolaryngol 40:29–35
11. De los Santos G, Reyes P, del Castillo R, Fragola C, Royuela A (2015) Cross-cultural adaptation and validation of the sino-nasal outcome test (SNOT-22) for Spanish-speaking patients. Eur Arch Otorhinolaryngol 272:3335–3340
12. Schalek P, Otruba L, Hahn A (2010) Quality of life in patients with chronic rhinosinusitis: a validation of the Czech version of SNOT-22 questionnaire. Eur Arch Otolaryngol 267:473–475
13. Kosugi EM, Chen VG, da Fonseca VM et al (2011) Translation, cross-cultural adaptation and validation of sinonasal outcome test (SNOT): 22 to Brazilian Portuguese. Braz J Otorhinolaryngol 77:663–669
14. Lange B, Thilsing T, Al-kalemji A, Baelum J, Martinussen T, Kjeldsen A (2011) The sino-nasal outcome test 22 validated for Danish patients. Dan Med Bull 58:A4235
15. Lu W, Qi F, Gao ZQ, Feng GD, Yuan XD, Jin XF (2008) Quality of life survey on patients with chronic rhinosinusitis by using Chinese version of the 22-item sinonasal outcome test (SNOT-22). Zhonghua Er Bi Yan Hou Tou Jing Wai Ke Za Zhi 43:18–21
16. Jalessi M, Farhadi M, Kamrava SK, Amintehran E, Asghari A, Rezaei Hemami M, Mobasseri A, Masroorchehr M (2013) The reliability and validity of the persian version of sinonasal outcome test 22 (snot 22) questionnaires. Iran Red Crescent Med J 15:404–408
17. Buckland JR, Thomas S, Harries PG (2003) Canthe sino-nasal outcome test-22 be used as a reliable outcome measure for successful septal surgery? Clin. Otolaryngol Allied Sci 28:43–47
18. Poirrier AL, Ahluwalia S, Goodson A et al (2012) Is the sinonasal outcome test-22 a suitable evaluation for septorhinoplasty? Laryngoscope 123:76–81
19. Mokkink LB, Terwee CB, Patrick DL, Alonso J, Stratford PW, Knol DL, Bouter LM, de Vet HCW (2010) International consensus on taxonomy, terminology, and definitions of measurement properties for health-related patient-reported outcomes: results of the COSMIN study. J Clin Epidemiol 63:737–745
20. Beaton DE, Bombardier C, Guillemin F, Ferraz MB (2000) Guidelines for the process of cross-cultural adaptation of self-report measures. Spine 25:3186–3191
21. Fokkens WJ, Lund VJ, Mullol J et al (2012) EPOS 2012: European position paper on rhinosinusitis and nasal polyps 2012. A summary for otorhinolaryngologists. Rhinology 50:1–12
22. Mozzanica F, Urbani E, Atac M, Scottà G, Luciano K, Bulgheroni C, De Cristofaro V, Gera R, Schindler A, Ottaviani F (2013) Reliability and validity of the Italian nose obstruction symptom evaluation (I-NOSE) scale. Eur Arch Otorhinolaryngol 270:3087–3094
23. Terwee CB, Bot SDM, de Boer MR, van der Windt DA, Knol DL, Dekker J, Bouter LM, de Vet HC (2007) Quality criteria were proposed for measurement properties of health status questionnaires. J Clin Epidemiol 60:34–42
24. Vittinghoff E, Glidden DV, Shiboski SC, McCulloch CE (2005) Regression methods in biostatistics: linear, logistic, survival, and repeated measures models. Springer; New York, pp 254–258
25. Wabnitz DA, Nair S, Wormald PJ (2005) Correlation between preoperative symptom scores, quality-of-life questionnaires, and staging with computed tomography in patients with chronic rhinosinusitis. Am J Rhinol 19:91–96