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Is Baseline SNOT-22 Able to Predict the Need for Nose or Sinus Surgery? A Prospective Multicenter Study

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ABSTRACT

Objective: Developing reliable and easy-to-use telemedicine tools is essential in primary care. We sought whether Sino-Nasal Outcome Test-22 could predict the need for surgery and localize pathology of rhinology patients and healthy volunteers solely based on the pattern of the baseline Sino-Nasal Outcome Test-22.

Methods: Baseline Sino-Nasal Outcome Test-22 from 66 healthy volunteers and 383 rhinology patients was collected blindly prior to diagnosis. Participants were then categorized into 4 groups according to their diagnosis: control, no surgery (i.e. medical condition), functional nose surgery, and sinus surgery. The difference between groups was assessed by a multinomial logistic regression adjusted for age, gender, asthma, tobacco, history of nose surgery, and trauma.

Results: The 22 items of Sino-Nasal Outcome Test differed significantly among the 4 groups ($P < .05$). Control subjects showed the lowest Sino-Nasal Outcome Test-22 scores for all items. Patients requiring sinus surgery and those listed for nose surgery exhibited a specific pattern of Sino-Nasal Outcome Test-22 score. Nasal and extranasal rhinology symptoms were more specific to the diagnosis than psychological or sleep dysfunction domains.

Conclusion: Distinct Sino-Nasal Outcome Test-22 patterns were associated with subjects' diagnosis. SNOT-22 was not only able to score severity but could also localize the disease, orientate the diagnosis, and predict the need for surgical treatment. The Sino-Nasal Outcome Test-22 may be the easy telemedicine tool the primary care needs for a better referral pattern.

Keywords: Nose surgery, primary care, sinus surgery, SNOT-22, telemedicine

Introduction

Sinonasal symptoms are a common cause of consultation in primary care leading to a heavy economic burden.[1,2] In the context of healthcare spending constraints and telemedicine driven by pandemic risk, general practitioners are increasingly committed to efficient management or swift referral. The quest for reliable tools to assess nose function has led to the development of a myriad of objective and subjective measures.[3,4] However, time constraint restricts clinicians' ability to actually use all tools developed in research studies. The Sino-Nasal Outcome Test-22 (SNOT-22) is a disease-specific questionnaire involving 22 symptoms combining rhinologic issues with general health issues. Besides sinus symptoms, it also includes items on the ability to perform a normal daily activity and evaluates the overall disease-specific quality of life.[3] It is used worldwide and validated in chronic rhinosinusitis.[5-7] It was also proven effective in other nose conditions.[8,9] The SNOT-22 outcome was proven reliable, consistent, responsive to treatment, and clinically relevant.[6] Expanding SNOT-22 use in all rhinology patients could further contribute to a better knowledge of the patients. We evaluated how we could exploit the full power of SNOT-22, far beyond quality of life and chronic rhinosinusitis.

The primary endpoint of this study was to evaluate whether baseline SNOT-22, collected prior to seeing the ear, nose, and throat (ENT) surgeon, could identify the diagnosis of patients and healthy volunteers. We sought whether the pattern of SNOT-22 answers could identify the need for surgery, and in

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case of surgery, whether it could localize pathology in the nose or in the sinus.

Methods

Subjects and Settings

This study was conducted in the rhinology clinics of 3 tertiary referral hospitals. Approval was obtained from the Ethical committees of the University Hospital UCL-Namur, the University Hospital of Liege and the University Hospital ULB Saint-Pierre under the Belgian number B039201318236, date: 09/19/2013. Subjects were recruited by enrollment of 520 consecutive patients presenting to the rhinology clinic of the 3 ENT academic departments regardless of their diagnosis. Healthy subjects were recruited by advertisement in the hospital restaurants hosting visitors and families. Written informed consent for collecting the anonymized data was obtained. General data and SNOT-22[10] from all participants were collected blindly prior to diagnosis. General data included age, sex, history of nose surgery, history of nose trauma, smoking, and asthma and allergy history. Patients with tumor, lacrimal condition, aesthetic concern, absence of clear diagnosis, or absence of consent were later excluded from the study (out of 520 target rhinology patients, 383 actually participated in the study). Patients were then categorized into 3 groups according to their outcome: no surgery (i.e., medical condition), nose surgery, and sinus surgery. The fourth group (control group) included healthy subjects recruited by advertisement in the hospital restaurant. The control group (n = 66) was defined by the absence of rhinological complaint and matched for age and sex to patient groups. The medical condition group (n = 101) was defined by rhinologic complaint requiring any form of non-surgical treatment. Patients requiring functional nose surgery (functional septorhinoplasty, septoplasty, and turbinoplasty) were included in the nose surgery group (n = 164). Patients requiring functional endoscopic sinus surgery were included in the sinus surgery group (n = 118). Patients with overlapping criteria (e.g., both sinus and nose surgery) were excluded from the study (n = 52). In total, 449 subjects participated in this study. The study flowchart is summarized in Figure 1.

Statistical Analysis

This prospective multicenter cohort study evaluated the ability of the SNOT-22 pattern to predict the need for surgery and to localize pathology in the nose or in the sinus. Quantitative variables were summarized by using median and interquartile range (P25-P75), while qualitative variables were described with frequency and percentage. For demographic quantitative variables, comparison between groups was tested by means of the Kruskal–Wallis non-parametric test. If necessary, multiple comparisons based on Dwass, Steel, Crichlow-Flinger (DSCF) method were evaluated. For demographic qualitative variables, the chi-squared test or the Fisher's exact test for qualitative variables was performed. Univariate multinomial logistic regressions adjusted for age, sex, asthma, tobacco, history of nose surgery, and trauma were then applied to determine the association between the outcome of subjects and each item of the SNOT-22. Odds ratios and 95% CI were also calculated to evaluate the risk to present a specific outcome. As SNOT-22 was first validated in sinus surgery, the sinus surgery group was chosen as the reference category. SNOT-22 subdomains relevant for each group were sought as the secondary endpoint. For this study, SNOT-22 subdomains were nasal symptoms, extra-nasal rhinologic symptoms, psychological symptoms, and sleep dysfunction as defined by DeConde et al.[9,11] Association between these subdomains and the groups was also assessed by means of univariate and multivariate multinomial logistic regression adjusted for age, sex, asthma, tobacco, previous nose and/or sinus surgery, and nose trauma. Statistical analysis was conducted using SAS 9.4 software. The result was considered significant at the uncertainty level of 5 % ($P < .05$).

Main Points

- Baseline Sino-Nasal Outcome Test-22 (SNOT-22) from 66 healthy volunteers and 383 rhinology patients was collected blindly prior to diagnosis.
- Participants were then categorized into 4 groups according to their diagnosis: control, no surgery (i.e., medical condition), functional nose surgery, and sinus surgery.
- Multinomial logistic regression adjusted for age, gender, asthma, tobacco, history of nose surgery, and trauma showed distinct SNOT-22 patterns associated with different diseases.
- Baseline SNOT-22 was able to predict the need for surgery and to discriminate patients for nose or sinus surgery.
- Beyond ear, nose, and throat clinics, SNOT-22 could be of interest to general practitioners.

Results

Demographic and clinical data are summarized in Table 1. As expected, age was different between 4 groups ($P < .0001$). Nose surgery patients were significantly younger than sinus surgery patients ($P < .0001$) or medical patients ($P < .0001$). Control subjects were older than medical patients ($P = .021$) but younger than sinus surgery patients ($P = .021$). As expected, the 4 groups were also heterogeneous by sex ($P = .025$), tobacco consumption ($P = .0009$), presence of asthma ($P = .0035$), history of nose surgery ($P < .0001$), and nose trauma ($P < .0001$).

Baseline SNOT-22 as Outcome Predictor

The 22 items of SNOT differed significantly among the 4 groups ($P < .05$, Table 2). Control subjects showed the lowest SNOT-22 scores for all items. Medical patients had lower scores than surgical patients but differences were globally not significant. Patients requiring sinus surgery and those listed for nose surgery exhibited a specific pattern of SNOT-22 score (Table 2). In total, 10 items of the SNOT-22 score showed significant difference between the sinus surgery group and the nose group (Table 2 and Figure 2). Patients with the need of sinus surgery were much more likely to complaint about sense of smell (#21, OR 0.51 [0.37-0.70], $P < .0001$), need to blow nose (#1, OR 0.55 [0.39-0.78], $P = .0008$), and facial pain (#10, OR 0.58 [0.43-0.77], $P = .0002$). Runny nose (#3, OR 0.62 [0.45-0.86], $P = .0037$), sneezing (#2, OR 0.67 [0.48-0.93], $P = .017$), cough (#4, OR 0.67 [0.49-0.91], $P = .011$), and ear pain (#9, OR 0.67 [0.49-0.91], $P = .0098$) were also characteristic of patients listed to sinus surgery. Patients with the need of nose surgery showed better scores compared to sinus surgery patients for items #6 thick nasal discharge (OR 0.70 [0.53-0.91], $P = .0082$), #5 post-nasal discharge (OR 0.74

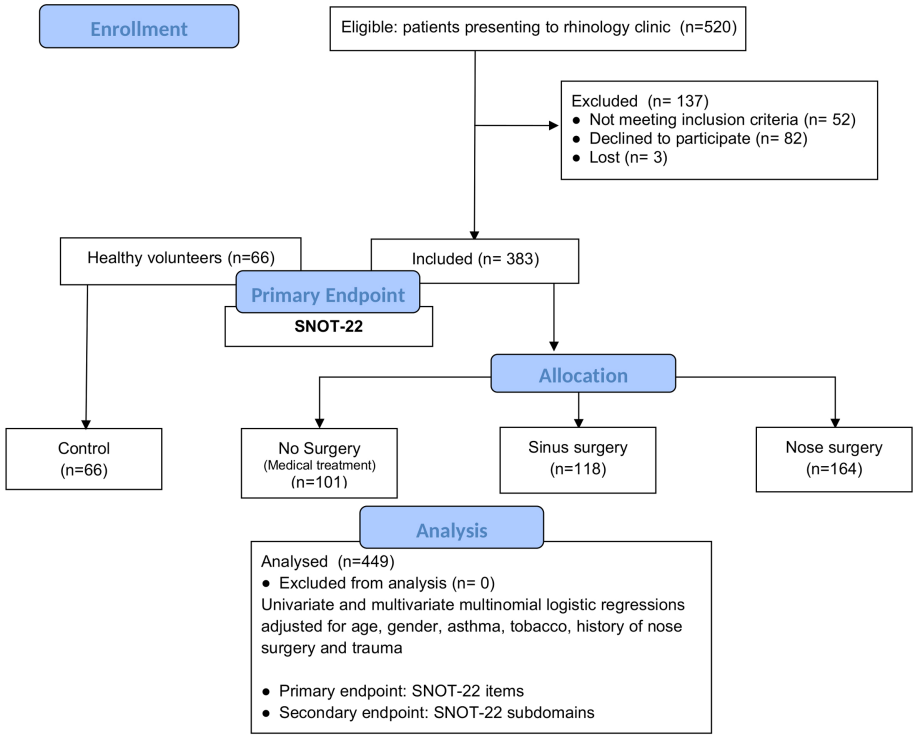

Figure 1. Study flowchart.

[0.56-0.96], $P=.026$), and #18 frustrated/irritable (OR 0.75 [0.56-0.99], $P=.041$) (Table 2 and Figure 2).

Sino-Nasal Outcome Test-22 Subdomains Analysis

Nasal (items #1, #2, #3, #6, #21, and #22) and extranasal (items #4, #5, and #6) rhinology symptoms were more specific to the diagnosis than psychological or sleep dysfunction domains (Table 3). Nasal and extranasal rhinology symptoms and ear/facial symptoms dimensions significantly differed when pathology was localized in the nose or in the sinus (respectively, $P<.0001$, $P=.0022$, and $P=.0009$, Table 3 and Figure 3). Multivariate multinomial logistic regression adjusted for age, sex, asthma, tobacco, previous nose and/or sinus surgery, and nose trauma showed a significant group prediction for the subdomain nasal rhinology symptoms ($P=.0041$, Table 4), with a better outcome measured in the nose surgery group. Other subdomains did not differ significantly.

Discussion

Distinct SNOT-22 patterns were associated with the subject's diagnosis and could predict treatment modality selection with or without rhinosinusitis. Baseline SNOT-22 was able to differentiate patients from controls, to score severity, to localize pathology in the sinus or in the nose, and to predict the need for surgical treatment. Therefore, this questionnaire not only reflected quality of life burden but was also associated to specific diagnosis and surgical outcome. Instead of focusing on the total SNOT-22 score, the present study prospectively assessed the pattern of SNOT-22 answers in healthy

Table 1. Demographic Data

	Control	Medical Condition	Nose Surgery	Sinus Surgery	*P*
Total, no	**66**	**101**	**164**	**118**	
Age, median (P25-P75), year	41.0 (30.0-56.0)	37.5 (30.0-51.0)	34.0 (26.0-47.0)	47.0 (36.0-62.0)	<.0001
Sex, no (%)					
Female	40 (60.6%)	43 (42.6%)	69 (42.1%)	45 (38.1%)	.025
Male	26 (39.4%)	58 (57.4%)	95 (57.9%)	73 (61.9%)	
Smoking, %	1 (1.5 %)	15 (17.4 %)	38 (24.4 %)	22 (20.8 %)	.0009
Allergy, %	20 (30.8 %)	43 (49.4 %)	66 (42.3 %)	49 (46.7 %)	.11
Asthma, %	1 (1.5 %)	15 (17.6 %)	18 (11.5 %)	21 (20.0 %)	.0035
Nose surgery history, %	2 (3.1 %)	31 (36.0 %)	44 (28.6 %)	44 (42.3 %)	<.0001
Nose injury, %	2 (6.1 %)	4 (11.8 %)	44 (41.9 %)	4 (15.4 %)	<.0001

Table 2. Multinomial Logistic Regression with Sinus Surgery as the Reference Category, Adjusted for Age, Sex, Asthma, Tobacco, Previous Nose and/or Sinus Surgery, and Nose Trauma. The 22 Items of SNOT Differed Significantly Among the 4 groups ($P < .05$)

	Control	Medical Condition	Nose Surgery	Sinus Surgery (Reference)	*P*
SNOT-22 Items		**Median (P25-P75)** Odds Ratio (CI 95%) *P*			
1. Need to blow nose	**1.0 (0.0-2.0)** 0.34 (0.21-0.54) <.0001	**3.0 (1.0-3.0)** 0.95 (0.65-1.39) .78	**2.0 (1.0-3.0)** 0.55 (0.39-0.78) .0008	**3.0 (2.0-4.0)**	<.0001
2. Sneezing	**0.0 (0.0-1.0)** 0.34 (0.19-0.59) .0001	**2.0 (0.0-3.0)** 0.81 (0.56-1.17) .26	**1.0 (0.0-2.0)** 0.67 (0.48-0.93) .017	**2.0 (1.0-3.0)**	.0012
3. Runny nose	**0.0 (0.0-2.0)** 0.41 (0.26-0.64) <.0001	**2.0 (0.0-3.0)** 0.78 (0.54-1.12) .18	**2.0 (0.0-3.0)** 0.62 (0.45-0.86) .0037	**3.0 (1.0-3.0)**	.0006
4. Cough	**0.0 (0.0-0.0)** 0.33 (0.18-0.62) .0006	**1.0 (0.0-3.0)** 0.90 (0.65-1.25) .53	**0.0 (0.0-2.0)** 0.67 (0.49-0.91) .011	**2.0 (0.0-3.0)**	.0014
5. Post-nasal discharge	**0.0 (0.0-1.0)** 0.52 (0.36-0.77) 0.0009	**3.0 (1.0-4.0)** 0.93 (0.69-1.25) 0.62	**2.0 (0.0-3.0)** 0.74 (0.56-0.96) 0.026	**3.0 (2.0-4.0)**	.0032
6. Thick nasal discharge	**0.0 (0.0-0.0)** 0.42 (0.26-0.69) .0006	**1.0 (0.0-4.0)** 0.96 (0.71-1.28) .77	**1.0 (0.0-2.0)** 0.70 (0.53-0.91) .0082	**3.0 (0.0-4.0)**	.0006
7. Ear fullness	**0.0 (0.0-0.0)** 0.21 (0.073-0.57) .0024	**1.0 (0.0-2.0)** 1.08 (0.78-1.50) .63	**1.0 (0.0-2.0)** 0.83 (0.62-1.12) .23	**1.0 (0.0-2.0)**	.0061
8. Dizziness	**0.0 (0.0-0.0)** 0.17 (0.044-0.64) .0092	**0.0 (0.0-2.0)** 1.18 (0.84-1.65) .34	**0.0 (0.0-1.0)** 0.81 (0.59-1.11) .18	**0.0 (0.0-1.0)**	0.0046
9. Ear pain/pressure	**0.0 (0.0-0.0)** 0.16 (0.051-0.48) .0013	**0.0 (0.0-1.0)** 0.90 (0.65-1.24) .52	**0.0 (0.0-2.0)** 0.67 (0.49-0.91) .0098	**1.0 (0.0-2.0)**	.0015
10. Facial pain/pressure	**0.0 (0.0-0.0)** 0.30 (0.17-0.54) <.0001	**1.0 (0.0-3.0)** 0.87 (0.64-1.17) .36	**0.0 (0.0-2.0)** 0.58 (0.43-0.77) .0002	**3.0 (0.0-4.0)**	<.0001
11. Difficulty falling asleep	**0.0 (0.0-0.0)** 0.19 (0.069-0.51) .0010	**1.0 (0.0-3.0)** 1.02 (0.76-1.37) .89	**2.0 (0.0-4.0)** 0.99 (0.77-1.29) .96	**2.0 (0.0-3.0)**	.0096
12. Waking up at night	**0.0 (0.0-1.0)** 0.26 (0.13-0.51) <.0001	**2.0 (0.5-3.0)** 1.05 (0.77-1.43) .76	**2.0 (1.0-3.0)** 0.94 (0.72-1.24) .67	**3.0 (1.0-4.0)**	.0007
13. Lack of a good night's sleep	**0.0 (0.0-1.0)** 0.35 (0.21-0.59) <.0001	**2.0 (1.0-4.0)** 1.14 (0.85-1.53) .38	**3.0 (1.0-4.0)** 1.00 (0.78-1.29) .99	**3.0 (1.0-4.0)**	.0001
14. Waking up tired	**0.5 (0.0-1.0)** 0.37 (0.22-0.62) 0.0002	**2.0 (1.0-4.0)** 1.24 (0.89-1.73) 0.20	**3.0 (2.0-4.0)** 1.11 (0.83-1.47) 0.49	**3.0 (1.0-4.0)**	<.0001
15. Fatigue during the day	**1.0 (0.0-1.0)** 0.41 (0.24-0.70) .0011	**2.0 (1.0-4.0)** 1.52 (1.05-2.19) .027	**2.0 (2.0-4.0)** 1.22 (0.90-1.67) .21	**2.5 (1.0-4.0)**	<.0001
16. Reduced productivity	**0.00 (0.00-0.00)** 0.36 (0.19-0.67) 0.0013	**2.00 (0.00-3.00)** 1.33 (0.94-1.89) 0.11	**2.00 (1.00-3.00)** 1.21 (0.89-1.63) 0.23	**2.00 (1.00-3.00)**	.0003

17. Reduced concentration	**0.0 (0.0-0.0)** 0.37 (0.22-0.63) .0002	**2.0 (0.0-3.0)** 1.02 (0.73-1.41) .93	**2.0 (1.0-3.0)** 0.94 (0.71-1.24) .66	**2.0 (1.0-3.0)**	.0012
18. Frustrated/restless/irritable	**0.0 (0.0-0.0)** 0.29 (0.16-0.51) <.0001	**1.0 (0.0-3.0)** 0.81 (0.58-1.12) .19	**2.0 (0.0-3.0)** 0.75 (0.56-0.99) .041	**2.0 (0.0-4.0)**	.0004
19. Sad	**0.0 (0.0-0.0)** 0.30 (0.13-0.66) .0030	**0.0 (0.0-2.0)** 1.01 (0.70-1.45) .98	**1.0 (0.0-2.0)** 1.04 (0.76-1.43) .80	**1.0 (0.0-2.0)**	.017
20. Embarrassed	**0.0 (0.0-1.0)** 0.29 (0.17-0.49) <.0001	**2.0 (1.0-3.0)** 0.88 (0.61-1.26) .48	**3.0 (1.0-4.0)** 0.88 (0.64-1.21) .43	**3.0 (2.0-4.0)**	<.0001
21. Sense of taste/smell	**0.0 (0.0-0.0)** 0.16 (0.076-0.34) <.0001	**2.5 (0.0-4.0)** 0.65 (0.47-0.90) .0095	**1.0 (0.0-3.0)** 0.51 (0.37-0.70) <.0001	**3.0 (1.0-5.0)**	<.0001
22. Blockage/congestion of nose	**0.0 (0.0-1.0)** 0.32 (0.20-0.51) <.0001	**3.0 (2.0-4.0)** 0.82 (0.58-1.17) .28	**4.0 (3.0-4.0)** 0.93 (0.67-1.28) .65	**4.0 (2.0-5.0)**	<.0001
Total SNOT-22	**6.0 (3.00-12.0)** 0.82 (0.76-0.88) <.0001	**36.0 (27.0-55.0)** 1.00 (0.97-1.02) .75	**40.0 (27.0-55.0)** 0.97 (0.94-0.99) .011	**47.5 (33.0-60.0)**	<.0001

volunteers and categorized patients suffering with sinonasal conditions. Our findings may provide a starting point to understand the different patterns of SNOT-22 indicative of different rhinology conditions. However, our study was not powered to compare symptoms of chronic rhinitis versus chronic sinusitis, or symptoms of structural versus mucosal pathology.

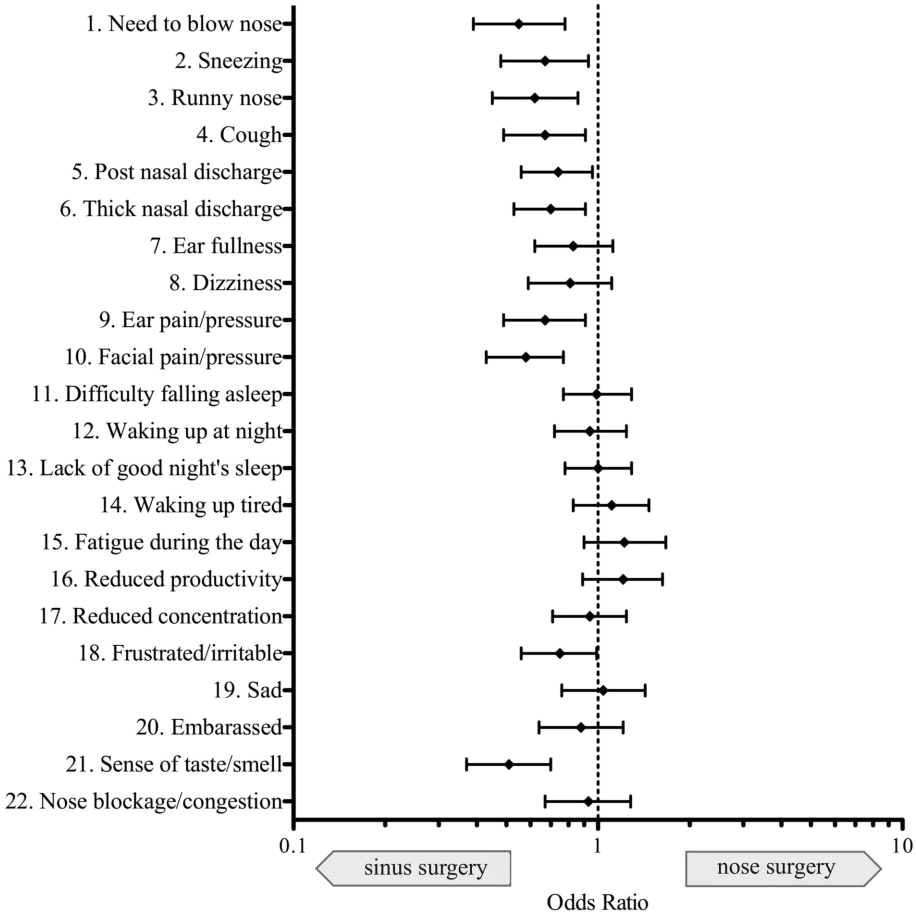

Figure 2. Odds ratio with 95% CIs for each SNOT-22 item comparing nose and sinus surgery. Patients requiring sinus surgery and those listed for nose surgery exhibited a specific pattern of SNOT-22 score. SNOT-22, Sino-Nasal Outcome Test-22.

Table 3. Univariate Multinomial Logistic Regression Adjusted for Age, Sex, Asthma, Tobacco, Previous Nose and/or Sinus Surgery, and Nose Trauma Applied to SNOT-22 Items Categorized into Clinically Relevant Sub-Domains. Nasal and Extranasal Items Were More Specific to the Diagnosis

	Control	Medical Condition	Nose Surgery	Sinus Surgery (Reference Group)	*P*
SNOT-22 Domains		**Median (P25-P75)** Odds Ratio (CI 95%) *P*			
Rhinologic symptoms (Survey items #1, #2, #3, #6, #21, #22)	**3.00 (1.00-6.00)** 0.58 (0.48-0.69) <.0001	**12.50 (8.50-17.00)** 0.91 (0.83-1.01) .063	**11.00 (8.00-15.00)** 0.83 (0.75-0.91) <.0001	**16.00 (11.00-20.50)**	**<.0001**
Extranasal rhino symptoms (Survey items #4, #5, #6)	**1.00 (0.00-2.00)** 0.65 (0.53-0.80) <.0001	**5.00 (3.00-9.00)** 0.96 (0.85-1.09) .55	**4.00 (1.00-7.00)** 0.83 (0.73-0.93) .0022	**7.00 (4.00-10.00)**	**<.0001**
Ear/facial symptoms (Surveys items #2, #7, #8, #9, #10)	**0.00 (0.00-2.00)** 0.49 (0.37-0.66) <.0001	**5.00 (2.00-10.00)** 0.98 (0.90-1.08) .72	**4.00 (2.00-8.00)** 0.85 (0.78-0.94) .0009	**7.00 (4.00-10.00)**	**<.0001**
Psychological dysfunction (Surveys items #14, #15, #16, #17, #18, #19, #20)	**2.00 (0.00-5.00)** 0.72 (0.62-0.83) <.0001	**12.00 (8.00-20.00)** 1.02 (0.96-1.09) .54	**15.00 (8.00-21.00)** 1.00 (0.95-1.06) .99	**15.00 (8.00-22.00)**	**<.0001**
Sleep dysfunction (Survey itemps #11, #12, #13, #14, #15)	**2.00 (0.00-4.00)** 0.70 (0.59-0.83) <.0001	**10.00 (5.00-16.00)** 1.04 (0.97-1.12) .28	**12.00 (6.00-17.00)** 1.01 (0.95-1.08) .74	**12.00 (5.00-18.00)**	**<.0001**

These comparisons would have been clinically meaningful. Further studies are needed to determine if SNOT-22 could discriminate against these patients. Although similarities were observed between nose and sinusitis patients in terms of total SNOT-22 score, specific items analysis was able to spot items and sub-domains of items associated with specific conditions. The populations of the rhinology clinics have abundant diversities and may vary from one clinic to another. We overcame this limitation by including a large number of patients from 3 academic, tertiary care rhinology centers.

Our results are in line with studies showing that magnitude of surgical improvement can be predicted by baseline SNOT-22 total score.[12-15] Meta-analysis by Solers et al[16] demonstrated that improvement after sinus surgery was influenced by a number of factors including baseline SNOT-22 score. However, 1 retrospective report found that SNOT-22 was unable to predict the need for surgery in 88 patients.[17] Erskine et al[18] found significant differences in the nasal domain of SNOT-22 between chronic rhinosinusitis with and without nasal polyps, exploiting even further the possibilities of this questionnaire. The SNOT-22-based analysis could also distinguish endotypes in chronic rhinosinusitis without nasal polyps with prognostic difference.[19]

The SNOT-22 subdomains we used were based on clinical relevance according to previous studies.[9,11] This categorization may be subject to debate. Item #2 ("sneezing") is categorized into nasal and facial sub-domain. Item #6 ("thick nasal discharge") is categorized into nasal and extranasal symptoms. While this overlap of items could be clinically meaningful, it may induce statistical bias. Other SNOT domain systems were described in older studies.[20-22] Previous findings already highlighted that

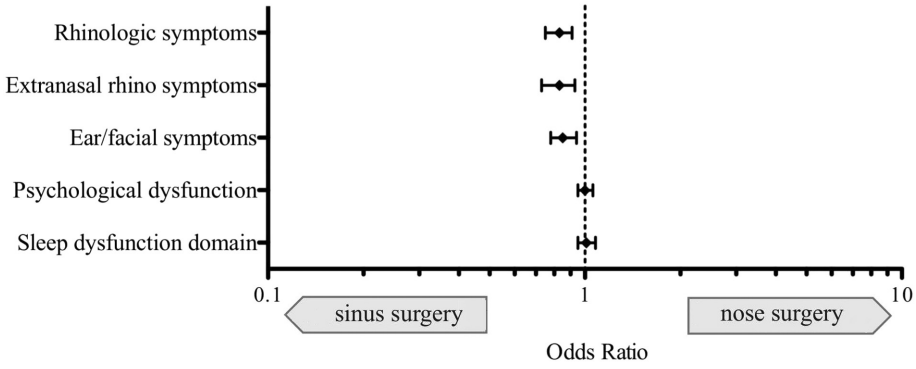

Figure 3. Odds ratio with 95% CIs for each SNOT-22 sub-domain comparing nose surgery and sinus surgery. The nasal and extranasal rhinology items were more diagnostic specific, with worse scores pointing to sinus surgery. SNOT-22, Sino-Nasal Outcome Test-22.s

Table 4. Multivariate Multinomial Logistic Regression Adjusted for Age, Sex, Asthma, Tobacco, Previous Nose and/or Sinus Surgery, and Nose Trauma Applied to SNOT-22 Items Categorized into Clinically Relevant Sub-Domains

SNOT-22 Domains		Odds Ratio (95% CI)	*P*
Rhinologic symptoms (survey items #1, #2, #3, #6, #21, #22)			.0041
	Control vs. sinus surgery	0.66 (0.52-0.84)	.0006
	Medical condition vs. sinus surgery	0.88 (0.77-1.00)	.056
	Nose surgery vs. sinus surgery	0.85 (0.76-0.96)	.0082
Extranasal rhino symptoms (survey items #4, #5, #6)			.74
	Control vs. sinus surgery	1.13 (0.81-1.57)	.47
	Medical condition vs. sinus surgery	1.03 (0.85-1.25)	.74
	Nose Surgery vs. sinus surgery	0.98 (0.82-1.17)	.81
Ear/facial symptoms (surveys items #2, #7, #8, #9, #10)			.15
	Control vs. sinus surgery	0.75 (0.52-1.07)	.11
	Medical condition vs. sinus surgery	1.02 (0.88-1.18)	.78
	Nose surgery vs. sinus surgery	0.91 (0.78-1.05)	.19
Psychological dysfunction (surveys items #14, #15, #16, #17, #18, #19, #20)			.55
	Control vs. sinus surgery	0.94 (0.74-1.19)	.58
	Medical condition vs. sinus surgery	0.99 (0.87-1.13)	.88
	Nose Surgery vs. sinus surgery	1.05 (0.93-1.19)	.45
Sleep dysfunction (survey items #11, #12, #13, #14, #15)			.48
	Control vs. sinus surgery	0.88 (0.67-1.15)	.34
	Medical condition vs. sinus surgery	1.06 (0.92-1.22)	.39
	Nose Surgery vs. sinus surgery	1.02 (0.89-1.16)	.80

SNOT-22 patterns could predict treatment modality selection in chronic rhinosinusitis.[23] Our study extends the use of SNOT-22 beyond this diagnosis. For specific domains, results should be interpreted with caution as other factors than the initial disease may interfere. SNOT-22 sub-domains of importance to patients may differ from domains of importance to physicians.[22] Females are known to score highly on SNOT score,[24] especially on sleep fatigue and facial domains.[25] Poor sleep quality is specifically associated with chronic rhinosinusitis.[26] Impairments in sleep and psychological SNOT-22 domains correlate with productivity losses.[27] Meta-analysis by Sukato et al[28] supports the current trend in the literature demonstrating that sleep quality, measured by multiple validated instruments, significantly improves after endoscopic sinus surgery. A statistical analysis to create and validate sub-domains of items could further help the clinician to determine the SNOT-22 cluster of items significantly related to each outcome. Our study was not designed to determine a mathematical model for cluster creation and further research is needed in this area.

Given the high prevalence of sinonasal symptoms and their associated impairment of quality of life and work productivity, a simple and effective outcome tool is essential. Patient-reported outcomes empower the individuals to record their disease themselves. However, there is often insufficient time to complete the disease-specific questionnaire for each condition in busy family practices. The SNOT-22 can fulfill the need of a versatile and effective tool, given that it is a short, practical, and straightforward test. Our study demonstrated that SNOT-22 was more efficient than expected as it was not only able to score severity but could also orientate the diagnosis. Ear, nose, and throat surgeons already use a variety of subjective and objective measures to determine when to perform surgery and to assess outcomes. Previous studies suggested the usefulness of SNOT-22 for sleep specialists[29] and pediatricians.[30] Our results suggest a possible clinical utility of SNOT-22 for general practitioners. The potential ability to predict the need for surgery and to discriminate patients for nose or sinus surgery could possibly help in the future for a better referral pattern and a better allocation of limited resources. This questionnaire not only reflected the quality of life but could also hint at diagnosis and could be used as a screening help in primary care. It could fulfill the need for a versatile and straightforward test, easy to implement in primary care, and helps to select the appropriate referral.

Conclusion

This study advocates for a broader use of SNOT-22, which is easy to implement in every practice for all patients with a sinonasal complaint. Parts of this scoring tool appear particularly relevant to nose patients, whereas other components are more appropriate to sinus patients.

Ethics Committee Approval: This study was approved by Ethics committees of the University Hospital UCL-Namur, the University Hospital of Liege and the University Hospital ULB Saint-Pierre under the Belgian number: B039201318236, date: 09/19/2013).

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