Measuring control of disease in Chronic Rhinosinusitis; assessing the correlation between SinoNasal Outcome Test-22 and Visual Analogue Scale item scores*

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Abstract

Background: In chronic rhinosinusitis (CRS), aim of treatment is control of disease. EPOS2020 suggests the use of visual analogue scale (VAS) measurements on several symptoms. We aim to determine if individual VAS items can be replaced by widely used SinoNasal Outcome Test-22 (SNOT-22) items when determining control of disease, to avoid using double measurements and to stimulate its use in clinical practice.

Methods: Analyses were made on correlations between individual SNOT-22 scores and symptom-specific questions from consecutive patients with CRS visiting our tertiary referral rhinologic clinic for the first time.

Results: 157 CRS patients were included. Correlations of individual items were strong (r>0.8). Best parity in sensitivity, specificity, positive predicting value, negative predicting value, odds ratio and Receiver Operating Characteristic curves were found in individual item score of VAS>5 and SNOT item-score ≥3. This cut off is valid for measuring control of disease, combining several nasal, facial pain and sleep symptoms (controlled, partially controlled and uncontrolled).

Conclusion: There is strong correlation between individual items measured as SNOT or VAS. For the definition of CRS disease control, as proposed in EPOS2020, the use of symptoms specific SNOT ≥3 is predictive of VAS>5.

Key words: paranasal sinus disease, health-related quality of life, control of disease, precision medicine

Introduction

In chronic rhinosinusitis (CRS), treatment is aimed at attaining control of disease. This is a state where complaints are absent, or at least not bothersome, without the need for rescue medication on top of topical steroids and/or saline rinses [(1)]. From a patient perspective, control of disease translates to alleviation of symptoms and is an important motivation for treatment adherence. In a controlled state, the impact of the disease on quality of life (QoL) is limited. In general, the concept of disease control is based on a combination of symptom severity and medication needed.

To estimate the current severity of the disease and its impact on QoL, several tools can be used. For CRS, the 22-item SinoNasal Outcome Test (SNOT-22) has become one of the most widely applied questionnaires to investigate disease-specific QoL in CRS [(2)]. Several studies have shown its applicability in CRS and its responsiveness to treatment [(3, 4)]. Also, shorter questionnaires on certain separate symptoms measured with a visual analogue scale (VAS) are often used instead, especially in digital solutions that monitor disease control, such as health diary apps [(5)]. Previous studies in conditions as allergic rhinitis have shown that a VAS can be used for this purpose [(6)]. For CRS, a study in 180 subjects showed a moderate correlation between an overall VAS and the SNOT-22 score, debatably claiming such a simple VAS can be used to 'assess disease severity, monitoring of the course of the disease, and (…) for treatment decisions and disease burden' [(7)]. When asking patients to rate their disease severity as mild, moderate or severe, by a VAS scale and by stating whether

they felt their QoL was affected, Lim at al. could define three levels of VAS scores (0-10 cm) in 116 CRS cases: 0-3 mild disease, >3-7 moderate, >7-10 severe [8]. Moreover, these three levels of self-reported disease severity have been shown to overlap well with SNOT-22 scores (0-20 mild, >20-50 moderate, >50-110 severe) in a small study with 65 CRS patients [9]. Similarly, in a study with 300 CRS patients, a SNOT-22 score of ≤25 was associated with self-reported well-controlled CRS [10]. In a more recent study of 309 CRS subjects, Philips et al. stepwise determined disease control, based on EPOS 2012 criteria, VAS, SNOT-22 and specifically asking subjects whether they rated their disease as 'controlled', 'partially controlled' or 'uncontrolled'. In their thorough analysis they describe a cut-off at VAS >3.5 corresponding with 'poorly controlled' symptom criteria on the EPOS 2012 descriptive scale [11].
Additionally, other studies have shown that the influence of extranasal symptom domains in the SNOT-22 (such as the ear and sleep domains) have a large impact on an overall VAS score [12-15].

The 2020 edition of the European Position Paper on Rhinosinusitis and Nasal Polyps (EPOS2020) describes the use of a VAS in individual symptoms (i.e., 'Nasal blockage', 'Rhinorrhoea / Postnasal drip', Facial pain / Pressure', 'Smell', 'Sleep disturbance or fatigue') to determine whether these symptoms are deemed bothersome or not; for research purposes a VAS of 5 or less may be interpreted as 'not bothersome' [1]. To our knowledge, there is hardly any data supporting the use of a VAS per symptom and how this would relate to the specific symptom-based questions in the SNOT-22 and/or the total SNOT-22 score. Not surprisingly, one of the research needs identified in EPOS2020 is 'Real life studies evaluating and validating cut off levels for visual analogue scale (VAS) or other measurements of control.' In the current study, we set out to determine the correlations between SNOT-22 individual items and symptom-specific questions (VAS) in a large CRS population, to explore on the EPOS2020 suggestion to use symptom-specific VAS scores or individual SNOT-22 items to determine disease control. The results of this study may directly impact clinical practice, as a clinician using SNOT-22 questionnaires in his or her practice, can now also reliably interpret degree of control based on the SNOT-22 items, instead of using multiple instruments (i.e., SNOT-22 and VAS measurements).

Materials and methods

Participants

Patients visiting our tertiary referral outpatient clinic were asked to fill in a set of questionnaires, including the SNOT-22 and several disease-specific symptoms measured as VAS. Additional presence of physician-diagnosed asthma, NSAID-exacerbated respiratory disease (N-ERD), and IgE or skin prick test confirmed aeroallergen sensitisation was recorded. In this study we included a consecutive series of adult patients who visited our clinic for the first time and were diagnosed with CRS with or without nasal polyps, according to EPOS criteria [1]. They were divided into two groups based on endoscopic findings: patients with nasal polyps (CRSwNP) and patients without nasal polyps (CRSsNP). No further CRS classification was applied.

Measurements

SNOT-22

The SNOT-22 is a widely used 22-item rhinosinusitis-specific questionnaire originally derived from the RSOM-31 [2, 16]. The SNOT-22 covers 4 subdomains potentially affected by CRS; nasal, sleep, otologic/facial pain, and emotional symptoms [17]. Patients score their symptoms from the last two weeks on a 6-item scale (0-5; 0) Not present/ no problem, 1) Very mild problem, 2) Mild or slight problem, 3) Moderate problem, 4) Severe problem, 5) Problem is "as bad as it can be").
The SNOT-22 has been found to be one of the best disease-specific Quality of Life (QoL) questionnaires in CRS based on the measurement goals, the discriminant validity, responsiveness, and the points obtained in the quality assessment [3, 4].

VAS

The visual analogue scale uses a 10-centimetre continuous line to indicate current symptom severity. Patients were asked to score the items 'Nasal blockage', 'Rhinorrhoea', 'Posterior nasal discharge', 'Facial pain (forehead, around the eyes, cheek), 'Reduced smell', 'Trouble sleeping' and 'Fatigue'. Scores range from no symptoms to worst symptoms possible (0-10). To explore the EPOS2020 suggestion for the use of symptom-specific VAS scores, patients scored these VAS items for several individual nasal symptoms comparable to the nasal SNOT-22 items.

Data analysis

Fully completed SNOT-22 questionnaires and fully completed individual VAS items were used for the analysis, to avoid calculating with imputed scores on the domain scores or extranasal symptoms.
The SNOT-22 scores were normally distributed, but the distribution of VAS symptoms scores was skewed to the left (i.e., the 'tail' in the distribution figure is on the left, and the mass of the distribution is on the right of the figure), therefore Spearman's rank correlation coefficient (r) was used to measure the association between SNOT-22 and VAS questions. The Spearman's rank correlation coefficient (range -1 to +1) is a standardized measure of the strength of relationship between two variables, where a score, whether it is positive or negative, of 0-0.5 indicates a weak, 0.5-0.8 a moderate and 0.8-1 a strong correlation [18].
To assess the best alternative symptom-specific SNOT-22 item score for the symptom-specific VAS items used for determining control of disease, sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated

for several cut-off points in SNOT-22 and VAS symptoms. Due to the difference in distribution of SNOT-22 scores (normally) and VAS scores (skewed to the left) we hypothesised that we might find the best parity in the upper range of the VAS scores (i.e., 5,6 or 7) and we chose to explore several arbitrary cut-off points in the upper half of the scales; SNOT ≥3 and SNOT>3 with VAS >5, VAS>6 and VAS>7. Corresponding odds ratios (OR) with 95% confidence intervals (95%CI) were calculated from the chi-squared test. Additionally, predictive ability was calculated using Receiver Operating Characteristic (ROC) curve analysis. Furthermore, Area Under the Curve (AUC) with sensitivity and 1-specificity were calculated. Best matching symptom specific SNOT-22 and VAS cut-off was chosen based on best on the highest AUC.

Clinical control of CRS as per EPOS2020

To assess SNOT-22 equivalent 'controlled', 'partially controlled' and 'uncontrolled' as described in EPOS2020, we divided patients accordingly in three groups, based on the individual SNOT-22 score on items 'Nasal obstruction', 'Rhinorrhoea' and 'Postnasal drip', 'Facial pain', 'Reduced smell', 'Trouble sleeping' and 'Fatigue'. In EPOS2020 two combined items are used: 'Rhinorrhoea / Postnasal drip' and 'Trouble sleeping and Fatigue', which were separate items in the SNOT-22 and VAS questionnaires. To determine the degree of control, we wanted to analyse the most bothering symptom, which would most likely affect the degree of control, so the highest score from either of the individual two items was used.

Symptoms were named the same in the Dutch SNOT-22 and VAS questionnaires, except for the sleeping items; SNOT-22-item 'Lack of a good night's sleep' was used as a surrogate for VAS item 'Sleeping problems'. 'Controlled' CRS was defined as all symptoms scored SNOT≤2. 'Partially controlled' disease was defined as at least one (but maximum two) of the symptoms present (i.e. SNOT-22 score ≥3). 'Uncontrolled' CRS was defined as 3 or more symptoms scored ≥3. As such, only the symptom severity portion of disease control was measured in this study; use of (rescue) medication or endoscopic appearance were not added as parameters. Mean SNOT-22 scores with standard deviation were calculated per group.

Statistical analysis

Statistical analyses were performed with IBM SPSS Statistics 26. Differences in characteristics were calculated through χ^2 test, One-way ANOVA test or Independent-samples Kruskal-Wallis Test, depending on whether categorical or numerical data were tested. A p-value below 0.05 was regarded statistically significant.

Results

During the 7-year study period we included 554 first-visits of patients with CRSwNP and patients with CRSsNP. In total 157 questionnaires from patients (mean age: 47 years (SD 14), 57% male) fulfilling the EPOS criteria for CRS were evaluated, of whom 85 (54%) patients with CRSwNP (Table 1). We found statistically significant more female patients with CRSsNP (54%) compared to female patients with CRSwNP (33%; χ^2=7.18, p:0.007). Allergy to common aeroallergens was statistically significant more prevalent in patients with CRSwNP (49%) than in patients with CRSsNP (22%; χ^2=12.0, p: 0.001), as was asthma: 51% in patients with CRSwNP and 28% in patients with CRSsNP (χ^2=7.7, p: 0.005), and N-ERD: 18% in patients with CRSwNP and none in patients with CRSsNP (χ^2=8.7, p: 0.003).

Table 1. Patient characteristics.

	Total n=157	CRSwNP n=85	CRSsNP n=72	p-value
Age (SD)	47 (14)	47 (13)	46 (14)	-
Gender (male) (n)	90	57	33	
%	57	67	46	0.007
Smoking – Never (n)	66	38	28	0.240
%	42	45	39	
Current (n)	28	11	17	
%	17	13	24	
Former (n)	59	33	26	
%	38	39	36	
Allergy (n)	58	42	16	0.001
%	37	49	22	
Asthma (n)	63	43	20	0.005
%	40	51	28	
N-ERD (n)	15	15	0	0.003
%	9.6	18	0	

CRSwNP: Chronic rhinosinusitis with nasal polyps; CRSsNP: Chronic rhinosinusitis without nasal polyps; p-value: p-value in chi-square test, compared between CRSwNP and CRSsNP; Allergy: Allergy to common aeroallergens; N-ERD: NSAID-Exacerbated Respiratory Disease.

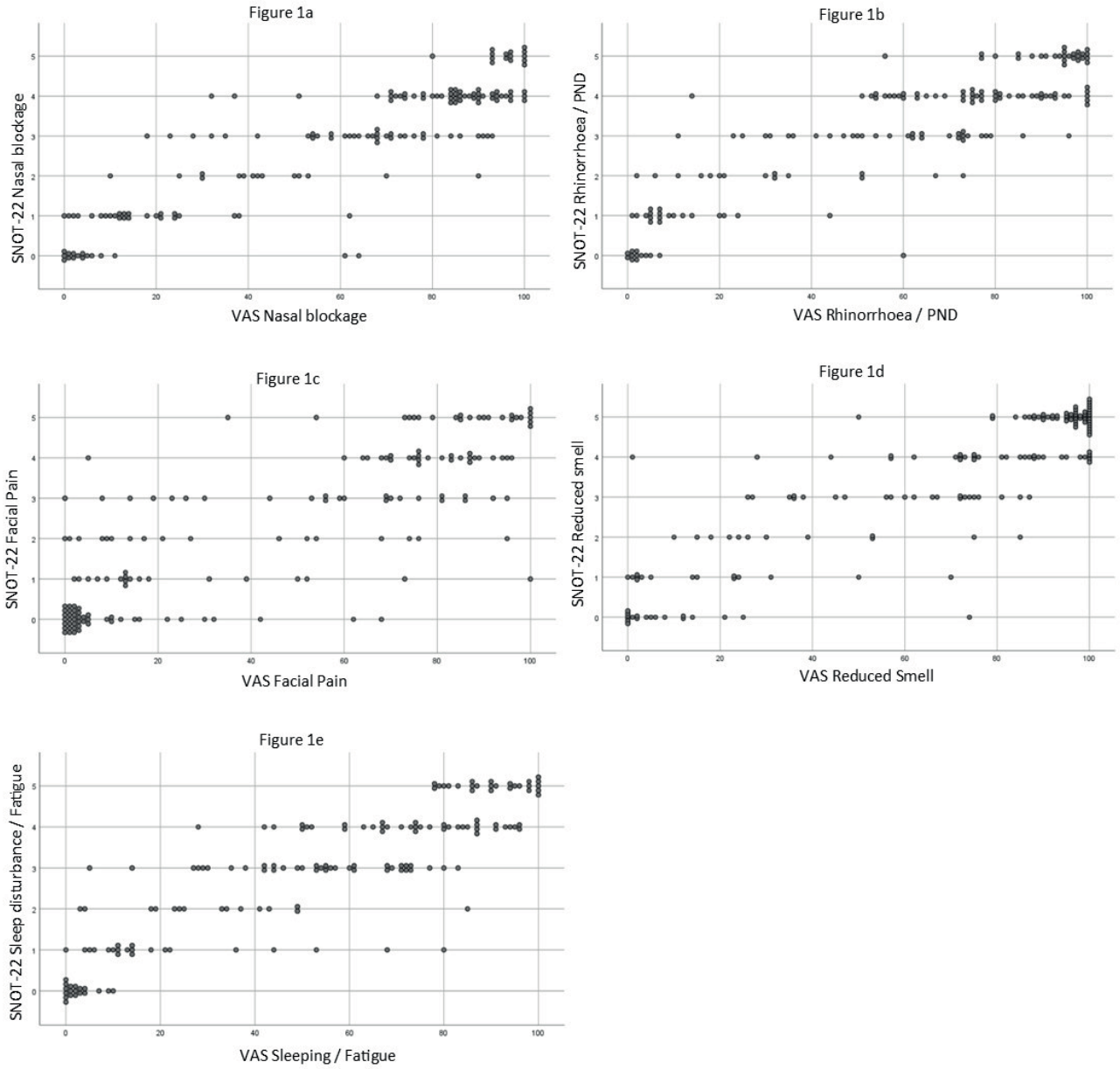
Table 2. Correlation of SNOT-22 and VAS items.

Individual items from SNOT-22 and specific VAS	Spearman's rho*
Nasal blockage	0.866
Rhinorrhoea / Postnasal drip	0.849
Facial pain / pressure	0.802
Sense of smell	0.857
Sleeping problems / Fatigue	0.866

*all p<0.001; VAS: Visual Analogue Scale; SNOT-22: SinoNasal Outcome Test. n=157.

Correlation in individual items

Correlation in individual items from SNOT-22 and VAS are strong



Figures 1. a-e) Correlation of individual SNOT and VAS items.

(Table 2; all correlations r>0.8). For the items required for the EPOS control scheme, the scatterplots of individual VAS and individual SNOT scores are depicted in Figures 1a-e.

Cut-off points for individual SNOT-22 and VAS items

Best parity between SNOT-22 and VAS individual items was found with a cut-off point of SNOT ≥3 and VAS >5, as shown in Table 3. Per symptom, the sensitivity and specificity: 'Nasal obstruction': sens: 86%, spec: 93%; 'Rhinorrhoea or PND': sens: 76%, spec: 95%; 'Facial pain': sens: 88%, spec: 86%; 'Reduced smell': sens: 77%, spec: 94%; 'Sleeping problems or fatigue': sens: 71%, spec: 95%. The AUC at VAS cut-off >5 was slightly better, compared to cut-off >7, although 95% confidence intervals were overlapping, this means there is no significant difference (Table 4). The Receiver Operating Characteristic (ROC) curve analysis and Area Under the Curve (AUC) with sensitivity and 1-specificity were calculated for VAS >5 (Figures 2a-e). Additionally, in Table 6, sensitivity, specificity, PPV, NPV, and OR are shown more extensively for several cut-off points (Table 6, online supplementary).

Table 3. Sensitivity, specificity, positive predictive value and negative predictive value per symptom. Cut-off: SNOT at ≥3 and VAS at >50.

Nasal obstruction	VAS		
SNOT	≤50	>50	
<3	48	7	55
≥3	8	94	102
	56	101	157
Sens	86	PPV	87
Spec	93	NPV	92
OR (95%CI)	80.57	27.6	235.4

Rhinorrhoea/PND	VAS		
SNOT	≤50	>50	
<3	42	5	47
≥3	13	97	110
	55	102	157
Sens	76	PPV	89
Spec	95	NPV	88
OR (95%CI)	62.68	21.01	187.00

Facial pain	VAS		
SNOT	≤50	>50	
<3	70	11	81
≥3	10	66	76
	80	77	157
Sens	88	PPV	86
Spec	86	NPV	87
OR (95%CI)	42.00	16.74	105.39

Smell	VAS		
SNOT	≤50	>50	
<3	40	6	46
≥3	12	99	111
	52	105	157
Sens	77	PPV	87
Spec	94	NPV	85
OR (95%CI)	55.00	19.31	156.63

Sleep/Fatigue	VAS		
SNOT	≤50	>50	
<3	51	4	55
≥3	20	82	102
	71	86	157
Sens	71	PPV	93
Spec	95	NPV	80
OR (95%CI)	52.28	16.90	161.66

Analysis on control of disease

Based on the EPOS2020 definition on current control of disease, based on scores of individual items ('Nasal blockage', 'Rhinorrhoea / Postnasal drip', 'Facial pain / Pressure', 'Smell' and 'Sleep disturbance or fatigue'), measured in VAS, patients were classified as 'controlled' (n=16, 10%, mean SNOT-22: 12.9), 'partially controlled' (n=40, 25%, mean SNOT-22: 30.1) or 'uncontrolled' (n=101, 64%, mean SNOT-22: 57.8). Measuring control of disease based on individual SNOT-22 items gives similar results: 'controlled' (n=16, 10%), 'partially controlled' (n=41, 26%) or 'uncontrolled' (n=100, 64%), with respective mean SNOT-22 scores 10.6, 29.8 and 58.6. (Tables 5a and b). There were no significant differences for CRSwNP or CRSsNP.

Discussion

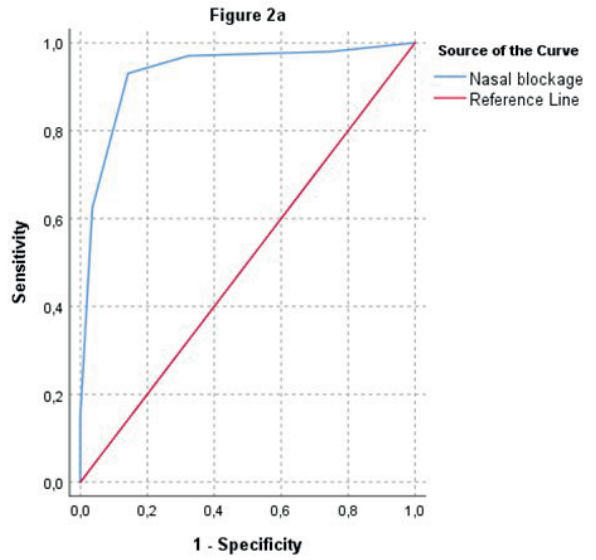
The aim of this study was to analyse the current EPOS2020 control guidelines. We set out to make a quantitative analysis on several cut-off points and to analyse if an item-specific SNOT-22 score could be used instead of a VAS item. To our knowledge, this study represents the first quantitative analysis on the correlation of SNOT-22 and VAS items in measuring control of disease. Table 2 and Figures 1a-e show that the correlation for individual items/symptoms is strong between SNOT-22 and VAS, at least for the items required for the EPOS control scheme.

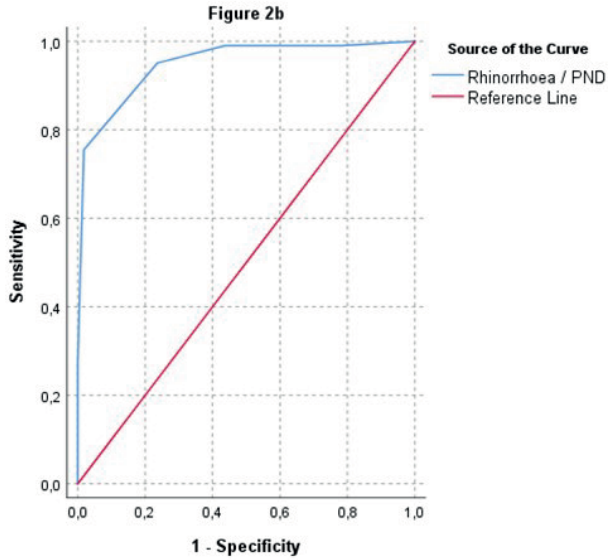
In search for an optimum cut-off and best parity between individual symptoms; we analysed several different possible combinations of SNOT-22 and VAS. We found best parity in sensitivity, specificity, positive predicting value, negative predicting value and odds ratio in VAS>5 and SNOT ≥3.

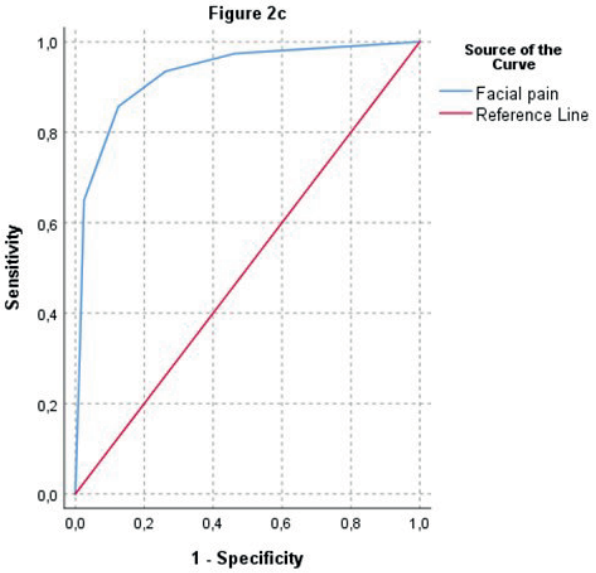
When observing the three patient groups, controlled, partially controlled and uncontrolled, that are thus obtained, the total SNOT-22 scores show a good overlap with those reported in literature for mild/moderate/severe CRS (Table 5). It is important to realise, however, that this only represents the symptom-derived part of disease control. The EPOS2020 definitions also entail nasal endoscopy and the need for rescue treatment. It is possible that in the current study, levels of control were overestimated (more patients 'controlled' or 'partially controlled') as these two factors were not accounted for. From a research point of view, it will be interesting to have future studies using symptom-specific scores and the need for rescue treatment, using SNOT ≥3 as cut-off, parallel with the clinical vs. epidemiological definition of CRS, which is based on symptoms, without nasal endoscopy or imaging.

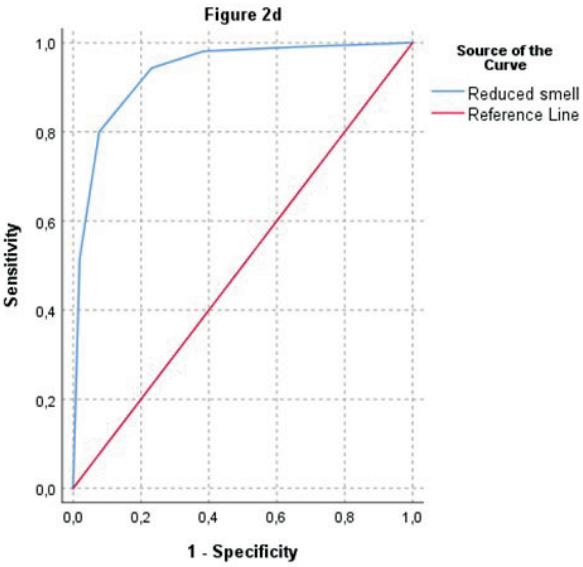
Limitations

A major limitation of the current study is its base population, namely CRS patients referred to our tertiary care hospital. This might reflect a more severe population, which is indeed suggested by the relatively high number of 'uncontrolled' patients (Table 5). We feel confident that the numbers are large enough









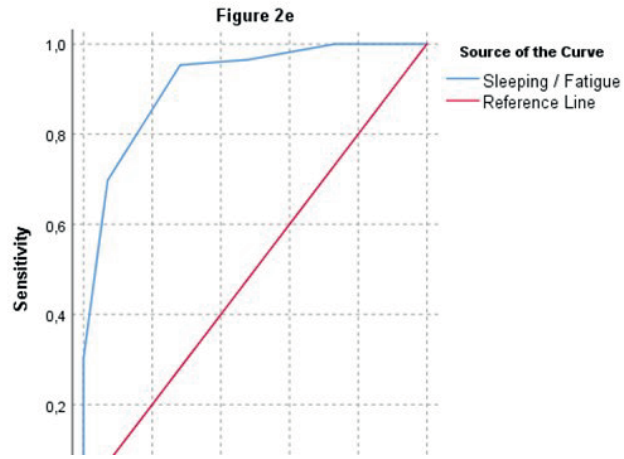


Figure 2. a-e) Receiver Operating Characteristic Curve for SNOT and VAS>50 in individual items.

Table 4. Area Under the Curve (AUC) with VAS >50 and VAS>70.

VAS>50	AUC	95% CI lower	95% CI upper
Blockage	0.932	0.889	0.975
Rhinorrhoea / PND	0.949	0.916	0.981
Facial Pain	0.928	0.886	0.970
Smell	0.935	0.893	0.977
Sleeping / Fatigue	0.915	0.837	0.958

VAS>70	AUC	95% CI lower	95% CI upper
Blockage	0.944	0.911	0.978
Rhinorrhoea / PND	0.891	0.843	0.940
Facial Pain	0.914	0.871	0.958
Smell	0.938	0.900	0.976
Sleeping / Fatigue	0.905	0.859	0.951

VAS: Visual Analogue Scale; AUC: Area Under the Curve; CI: confidence interval; PND: Postnasal drip.

to also represent milder cases sufficiently, but it cannot be excluded that results would be different in a more general population, or at the level of secondary care.

Another important limitation of this study is the lack of a golden standard for disease severity and/or symptom severity. We can only point to the internal consistency of our data, and to the large amount of overlap with the data already published from other studies [5, 7-9, 13-15]. This internal and external consistency suggests that the already defined cut-offs for mild/moderate/severe CRS for SNOT-22 scores are valid.

Conclusion

There is strong correlation between individual items measured as SNOT-22 or VAS. For the definition of CRS disease control, as proposed in EPOS2020, the use of symptoms specific SNOT ≥3 (as 'moderate problem' or worse) is predictive of VAS>5.

Authorship contribution

DDdL: study design, data collection, data analysis, literature search, writing manuscript. MC: data collection, data interpretation, writing manuscript. CH: data interpretation, correcting manuscript. WF: study design, data collection, data interpretation, writing manuscript. SR: data interpretation, writing manuscript.

Conflict of interest

All authors declare that there are no conflicts of interest.

Table 5a and 5b. Controlled – partially controlled – uncontrolled CRS based on VAS and SNOT-22 items

A

Controlled CRS (all items ≤50)			
VAS	CRS	wNP	sNP
n=	16 (10%)	8	8
Mean SNOT-22	12.9	13.5	12.4
SD	6.2	7.4	5.3
Partially controlled CRS (1 or 2 items >50)			
VAS	CRS	wNP	sNP
n=	40 (25%)	21	19
Mean SNOT-22	30.1	23.6	37.2
SD	16.6	13.4	17.1
Uncontrolled CRS (≥3 items >50)			
VAS	CRS	wNP	sNP
n=	101 (64%)	56	45
Mean SNOT-22	57.8	58.1	57.4
SD	18.0	19.1	17.1

B

Controlled CRS (all items <3)			
VAS	CRS	wNP	sNP
n=	16 (10%)	8	8
Mean SNOT-22	10.6	10.1	11.1
SD	5.8	3.5	7.6
Partially controlled CRS (1 or 2 items ≥3)			
VAS	CRS	wNP	sNP
n=	41 (26%)	23	18
Mean SNOT-22	29.8	24.0	37.1
SD	13.1	10.1	12.8
Uncontrolled CRS (≥3 items ≥3)			
VAS	CRS	wNP	sNP
n=	100 (64%)	54	46
Mean SNOT-22	58.6	59.7	57.2
SD	18.0	18.0	18.1

n=157. CRS: Chronic rhinosinusitis; VAS: Visual Analogue Scale; SNOT-22: SinoNasal Outcome Test-22; SD: Standard deviation; wNP: Chronic rhinosinusitis with nasal polyps; sNP: Chronic rhinosinusitis without nasal polyps.

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This manuscript contains online supplementary material

SUPPLEMENTARY MATERIAL

Tables 6. Sensitivity, specificity, positive predictive value and negative predictive value per symptom.

Cut-off: SNOT at 3 and VAS at 50.

Nasal obstruction	VAS		
SNOT	≤50	>50	
≤3	54	38	79
>3	2	63	78
	56	101	157
Sens	96	PPV	59
Spec	62	NPV	97
OR (95%CI)	44.76	10.32	194.22

Smell	VAS		
SNOT	≤50	>50	
≤3	48	21	69
>3	4	84	88
	52	105	157
Sens	92	PPV	70
Spec	80	NPV	95
OR (95%CI)	48.00	15.56	148.08

Rhinorrhoea/PND	VAS		
SNOT	≤50	>50	
≤3	54	25	79
>3	1	77	78
	55	102	157
Sens	98	PPV	68
Spec	75	NPV	99
OR (95%CI)	166.32	21.87	1264.90

Sleep/Fatigue	VAS		
SNOT	≤50	>50	
≤3	66	26	92
>3	5	60	65
	71	86	157
Sens	93	PPV	72
Spec	70	NPV	92
OR (95%CI)	30.46	11.00	84.39

Facial pain	VAS		
SNOT	≤50	>50	
≤3	78	27	105
>3	2	50	52
	80	77	157
Sens	98	PPV	72
Spec	65	NPV	96
OR (95%CI)	72.22	16.45	317.13

Cut-off: SNOT at 3 and VAS at 70

Nasal obstruction	VAS		
SNOT	<=70	>70	
≤3	77	15	92
>3	4	61	65
	81	76	157
Sens	95	PPV	84
Spec	80	NPV	94
OR (95%CI)	78.28	24.71	247.97

Rhinorrhoea/PND	VAS		
SNOT	<=70	>70	
≤3	67	12	79
>3	17	61	78
	84	73	157
Sens	80	PPV	85
Spec	84	NPV	78
OR (95%CI)	20.03	8.86	45.32

Facial Pain	VAS		
SNOT	<=70	>70	
<=3	92	13	105
>3	10	42	52
	102	55	157
Sens	90	PPV	88
Spec	76	NPV	81
OR (95%CI)	29.72	12.07	73.22

Smell	VAS		
SNOT	<=70	>70	
≤3	57	12	69
>3	7	81	88
	64	93	157
Sens	89	PPV	83
Spec	87	NPV	92
OR (95%CI)	54.96	20.39	148.19

Sleep/Fatigue	VAS		
SNOT	<=70	>70	
≤3	81	11	92
>3	15	50	65
	96	61	157
Sens	84	PPV	88
Spec	82	NPV	77
OR (95%CI)	24.55	10.45	57.67

Cut-off: SNOT at 2 and VAS at 50

Nasal obstruction	VAS		
SNOT	≤50	>50	
≤2	48	7	55
>2	8	94	102
	56	101	157
Sens	86	PPV	87
Spec	93	NPV	92
OR (95%CI)	80.57	27.6	235.4

Rhinorrhoea/PND	VAS		
SNOT	≤50	>50	
≤2	42	5	47
>2	13	97	110
	55	102	157
Sens	76	PPV	89
Spec	95	NPV	88
OR (95%CI)	62.68	21.01	187.00

Facial Pain	VAS		
SNOT	≤50	>50	
≤2	70	11	81
>2	10	66	76
	80	77	157
Sens	88	PPV	86
Spec	86	NPV	87
OR (95%CI)	42.00	16.74	105.39

Smell	VAS		
SNOT	≤50	>50	
≤2	40	6	46
>2	12	99	111
	52	105	157
Sens	77	PPV	87
Spec	94	NPV	85
OR (95%CI)	55.00	19.31	156.63

Sleep/Fatigue	VAS		
SNOT	≤50	>50	
≤2	51	4	55
>2	20	82	102
	71	86	157
Sens	71	PPV	93
Spec	95	NPV	80
OR (95%CI)	52.28	16.90	161.66

Cut-off: SNOT at 2 and VAS at 60

Nasal obstruction	VAS		
SNOT	<=60	>60	
≤2	50	5	55
>2	15	87	102
	65	92	157
Sens	77	PPV	91
Spec	95	NPV	85
OR (95%CI)	59.00	19.89	169.13

Rhinorrhoea/PND	VAS		
SNOT	<=60	>60	
≤2	45	2	47
>2	27	83	110
	72	85	157
Sens	63	PPV	96
Spec	98	NPV	75
OR (95%CI)	69.17	15.72	304.28
AUC (sens/1-spec)	.801	.976	.375

Facial Pain	VAS		
SNOT	<=60	>60	
≤2	73	8	81
>2	17	59	76
	90	67	157
Sens	81	PPV	81
Spec	88	NPV	78
OR (95%CI)	31.67	12.78	78.49

Smell	VAS		
SNOT	<=60	>60	
≤2	42	4	46
>2	17	94	111
	59	98	157
Sens	71	PPV	91
Spec	96	NPV	85
OR (95%CI)	58.06	18.41	183.06

Cut-off: SNOT at 2 and VAS at 70

Nasal obstruction	VAS		
SNOT	<=70	>70	
≤2	54	1	55
>2	27	75	102
	81	76	157
Sens	67	PPV	98
Spec	99	NPV	74
OR (95%CI)	150.00	19.77	1137.95

Rhinorrhoea/PND	VAS		
SNOT	<=70	>70	
≤2	46	1	47
>2	38	72	110
	84	73	157
Sens	55	PPV	98
Spec	99	NPV	65
OR (95%CI)	87.16	11.57	656.86

Facial Pain	VAS		
SNOT	<=70	>70	
≤2	76	5	81
>2	26	50	76
	102	55	157
Sens	75	PPV	94
Spec	91	NPV	66
OR (95%CI)	29.23	10.53	81.18

Smell	VAS		
SNOT	<=70	>70	
≤2	43	3	46
>2	21	90	111
	64	93	157
Sens	67	PPV	93
Spec	97	NPV	81
OR (95%CI)	61.43	17.37	217.24

Sleep/Fatigue	VAS		
SNOT	<=70	>70	
≤2	53	2	55
>2	43	59	102
	96	61	157
Sens	55	PPV	96
Spec	97	NPV	58
OR (95%CI)	36.36	8.40	157.43

Cut-off: SNOT at 3 and VAS at 60

Nasal obstruction	VAS		
SNOT	<=60	>60	
≤3	62	30	92
>3	3	62	65
	65	92	157
Sens	95	PPV	67
Spec	67	NPV	95
OR (95%CI)	42.71	12.39	147.29

Rhinorrhoea/PND	VAS		
SNOT	<=60	>60	
≤3	60	19	79
>3	12	66	78
	72	85	157
Sens	83	PPV	76
Spec	78	NPV	85
OR (95%CI)	17.39	7.78	38.76

Facial Pain	VAS		
SNOT	<=60	>60	
≤3	86	19	105
>3	4	48	52
	90	67	157
Sens	96	PPV	82
Spec	71	NPV	92
OR (95%CI)	54.32	17.47	167.91

Smell	VAS		
SNOT	<=60	>60	
≤3	53	16	69
>3	6	82	88
	59	98	157
Sens	90	PPV	77
Spec	84	NPV	93
OR (95%CI)	45.27	16.66	123.04

Sleep/Fatigue	VAS		
SNOT	<=60	>60	
≤3	75	17	92
>3	9	56	65
	84	73	157
Sens	89	PPV	82
Spec	77	NPV	86
OR (95%CI)	27.45	11.40	66.11