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Journal

International Forum of Allergy & Rhinology, 6(9)

ISSN

2042-6976

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Publication Date

2016-09-01

DOI

10.1002/alr.21776

Peer reviewed

HHS Public Access

Author manuscript

Int Forum Allergy Rhinol. Author manuscript; available in PMC 2017 September 01.

Published in final edited form as:

Int Forum Allergy Rhinol. 2016 September ; 6(9): 906–913. doi:10.1002/alr.21776.

Improvements in psychological dysfunction after endoscopic sinus surgery for patients with chronic rhinosinusitis

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Abstract

Background—Psychological dysfunction is highly prevalent among patients with chronic rhinosinusitis (CRS). Previous study has identified various measures of anxiety and depression as predictors of quality-of-life outcomes following endoscopic sinus surgery (ESS). Psychological dysfunction scores, as measured by the 22-item SinoNasal Outcome Test (SNOT-22), have been found to influence treatment decision making in CRS. This study aims to further elucidate improvement in discrete psychological symptoms following ESS for CRS.

Methods—Adult patients with medically recalcitrant CRS electing to undergo ESS were prospectively enrolled into a multi-institutional, observational cohort. Psychological-related symptom severity and postoperative outcomes were assessed using psychological domain items of the SNOT-22, including subgroup analysis of patients with and without comorbid depression.

Results—A total of 374 participants met inclusion criteria and were followed postoperatively for an average of 14.6[SD=5.0] months. Total mean psychological domain scores improved from 15.9[8.2] to 8.5[8.4] ($p<0.001$). Significant relative mean improvements were reported in “waking up tired” (23%;$p<0.001$), “fatigue” (25%;$p<0.001$), “reduced productivity” (28%;$p<0.001$), “reduced concentration” (27%;$p<0.001$), “ frustrated/restless/irritable” (27%;$p<0.001$), “sad”

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Potential Conflicts of Interest: None

Accepted for podium presentation to the American Rhinologic Society during the 119th annual Combined Otolaryngologic Spring Meeting (COSM) in Chicago, IL, May 18–22nd, 2016.

Financial Disclosures: Timothy L. Smith and Jess C. Mace are supported by a grant for this investigation from the National Institute on Deafness and Other Communication Disorders (NIDCD), one of the National Institutes of Health, Bethesda, MD., USA (**R01 DC005805**; PI/PD: TL Smith). Public clinical trial registration (www.clinicaltrials.gov) ID# NCT01332136. Adam S. DeConde is a consultant for IntersectENT, (Menlo Park, CA) which is not affiliated with this investigation. There are no financial disclosures for Joshua M. Levy or Toby O. Steele.

(15%;p<0.001), and “embarrassed” (8%;p<0.001) scores. A total of 64–66% of participants reported improvement in “reduced productivity”, “waking up tired”, “fatigue” and “frustrated/restless/irritable”, compared to 46% and 38% reporting improvement in “sad” and “embarrassed”, respectively.

Conclusion—Patients with CRS report significant improvement in common mental health related symptoms following ESS. Despite these improvements, some degree of persistent postoperative psychological dysfunction was reported. Further study is necessary to determine which factors are associated with persistent psychological dysfunction after ESS in order to optimize treatment outcomes.

MeSH Key Words

Sinusitis; psychology; quality of life; patient outcome assessment

INTRODUCTION

Chronic rhinosinusitis (CRS) is a chronic inflammatory condition found in 5 –16% of adults in the United States, with a significant impact on health-related quality-of-life (QOL) and an associated annual economic burden of $22 billion USD.[1,2] Patient-related outcome measures (PROMs) are commonly used to evaluate QOL among patients undergoing treatment for CRS, but suffer from a poor correlation between patient-reported scores and measures of sinonasal inflammation, including radiographic and endoscopic findings.[3–5] Comorbid clinical phenotypes have been examined in attempt to account for this disparity, with recent studies describing the impact of psychological dysfunction on disease-state QOL among patients with CRS.[6–10]

Symptoms of psychological dysfunction play an important role in treatment planning and prognosis for the 20–25% of patients with CRS and a comorbid diagnosis of depression or anxiety.[6,9,11] Psychological dysfunction is associated with increased healthcare utilization, antibiotic use, and missed workdays among patients with CRS.[4,12] Furthermore, CRS patients with symptomatic depression have reduced pre and postoperative QOL relative to patients without psychological dysfunction.[7,8]

The 22-item SinoNasal Outcome Test (SNOT-22) is a PROM with assessment of five disease-specific domains. The component domains include three sinus-specific symptom domains (rhinologic, extranasal rhinologic, and ear/facial symptoms) and the general health-related QOL domains of sleep and psychological dysfunction.[13] Recent study has reported the effect of ESS on the SNOT-22 sleep domain symptom items.[14] The total psychological domain scores of the SNOT-22 have been shown to associate with treatment decision making among patients with CRS[15], however the influence of ESS on discrete psychological symptoms has not been previously described.

This study aims to evaluate the outcomes of ESS as measured by discrete psychological symptoms among patients with CRS. Subgroup analysis of patients with comorbid depressive disorder, CRS with nasal polyposis and previous ESS will be completed to further evaluate their impact on health-related QOL. Improved understanding of

psychological dysfunction and response to treatment has significant implications in the burden of disease and treatment planning among patients with CRS.

MATERIALS and METHODS

Patient / Cohort Population

All study patients were diagnosed with medically refractory CRS as described by both the American Academy of Otolaryngology-Head and Neck Surgery and the European Position Paper on Rhinosinusitis and Nasal Polyps 2012 (EPOS 2012).[16,17] Adult study patients (≥18 years of age) were recruited as part of a prospective, multi-center, observational cohort study developed to evaluate treatment outcomes of ESS using a non-randomized methodology. The Institutional Review Board (IRB) at each enrollment site governed all study protocols, informed consent documentation, and data safety monitoring. Enrollment sites consisted of sinus and skull base surgery centers located within academic hospital systems in North America including: Oregon Health & Science University (OHSU; Portland, OR; eIRB#7198), Stanford University (Palo Alto, CA; IRB#4947), the Medical University of South Carolina (Charleston, SC; IRB#12409), and the University of Calgary (Calgary, Alberta, Canada; IRB#E-24208), with central study coordination at OHSU. All consenting patients were assured by trained research personnel that study participation involved minimal risk and was completely voluntary per guidelines established by the *International Conference on Harmonisation.*[18]

Study participants voluntarily selected ESS as the subsequent treatment option for mitigation of symptoms related to CRS following initial medical therapy including, but not limited to, at least one course of either topical corticosteroids (≥21-days) or a 5-day course of oral corticosteroid therapy, and at least one course (≥14-days) of culture-directed or broad spectrum antibiotic therapy. Study enrollment meetings took place subsequent to study participants electing ESS, during which participants were screened for demographic information, as well as social and medical history including covariates listed in Table 2. Participants were followed through the standard of care for up to 18-months following surgery and were asked to complete postoperative evaluation procedures at regular 6-month intervals, either during physician-directed clinical presentations or via follow-up mailings utilizing the postal service and self-addressed return envelopes. Previous findings from this investigation have been reported.[6,13,15]

Endoscopic Sinus Surgery Procedures

Surgical intervention was non-standardized but directed by the intraoperative discretion of the enrolling physician at each enrollment location and reflected individual patient requirements and disease progression. Study participants were either primary or revision ESS cases. Procedural types included unilateral or bilateral maxillary antrostomy, total or partial ethmoidectomy, sphenoidotomy, or frontal sinusotomy procedures (*Draf* 1, 2a, 2b, or 3), with either adjunctive inferior turbinate reduction or septoplasty as needed to maximize sinonasal openings. Image guidance visualization was used prudently when necessary. Postoperative therapeutic regimens were prescribed as needed but included, at a minimum, 8 oz. daily low-pressure nasal saline irrigation to promote optimal postoperative healing.[19,20]

Exclusion Criteria

Participants were excluded from final analyses if no follow-up evaluations (≥6-months) were obtained during the study period. Participants were considered lost to follow-up if no postoperative evaluations were completed within 18 months after the date of ESS. Additionally, subjects with either ciliary dyskinesia /cystic fibrosis and /or corticosteroid dependent comorbidity were excluded from final analysis due to variations in global health and differential treatment considerations surrounding standard of care.

Imaging Evaluations of Disease Severity

Measures of disease severity, collected as part of the standard of care, were used simultaneously as investigational cofactors. Preoperative, high resolution computed tomography (CT) was evaluated without contrast to assess sinonasal disease severity using 1mm contiguously sliced images in the axial plane. Bilateral image staging was completed by the enrolling physician at each site in accordance with the Lund-Mackay scoring system (range: 0–24) which estimates opacification severity in the maxillary, ethmoidal, sphenoidal, ostiomeatal complex, and frontal sinus regions.[21] Postoperative CT images were not routinely collected, unless required by the standard of care, due to risk of elevated radiation exposure.

Sinonasal regions were evaluated using rigid, fiberoptic endoscopes (Karl Storz, Tuttlingen, Germany) both before and after ESS. Bilateral endoscopic examinations were staged by each enrolling physician using the Lund-Kennedy scoring system (range: 0–20) which estimates pathologic characteristics within the paranasal sinuses including the severity of nasal polyposis, discharge, edema, scarring, and crusting.[22] Higher total scores on either staging system reflect worse disease severity.

Outcome Measures of the Psychological Domain

Participants were asked to complete preoperative and postoperative patient-based evaluations of sinonasal disease, including the brief 22-item SinoNasal Outcome Test (SNOT-22; c2006, Washington University, St. Louis, MO), to estimate CRS-related symptom severity. The overall SNOT-22 instrument is a validated outcome survey designed to evaluate chronic sinonasal conditions.[23] Symptom severity is measured using Likert-scale responses which indicate: 0= “No problem”, 1= “Very mild problem”, 2=”Mild or slight problem”, 3= “Moderate problem”, 4= “Severe problem”, and 5= “Problem as bad as it can be”. Additionally, five symptom domains of the SNOT-22 instrument have been previously identified via exploratory factor analysis and involve summarization of discrete survey items as described in Table 1.[13] For the purposes of this investigation, psychological symptom severity was operationalized by the seven component survey items which comprise the psychological symptom domain of the SNOT-22. The enrolling physician at each study site was blinded to all patient-based survey responses at all times.

Additionally, study participants were asked to complete the Patient Health Questionnaire-2 (PHQ-2) as a validated screening tool for depressive disorders.[24] It is comprised of the first two questions of the longer Patient Health Questionnaire-9 (PHQ-9), and queries patients about the severity of depressed mood and anhedonia (range: 0–6). Participants are asked to

report how frequently they have experienced: 1) little interest or pleasure in doing things and 2) feeling down, depressed, or hopeless in the past two weeks using responses ranging from: 0= 'Not at all" to 3= "Nearly every day". A traditional cut-point of 3 or greater was used to identify at risk participants.[25]

Sample Size, Data Collection, and Statistical Analyses

To significantly detect a 1.0 score difference on SNOT-22 survey items, corresponding to the smallest discernible change in Likert scale score responses for each psychological symptom over time, a two-tailed test for dependent means requires a minimum of 31 subjects assuming 80% power (1-β error probability), a 5% alpha level, an equal variance assumption of 1.5 units, and a conservative between group correlation coefficient of 0.200.[26]

Protected health information was removed and study data was safeguarded using unique study identification number assignments for each participant. All study data was securely transferred to OHSU from each enrollment site for manual entry into a password protected relational database (Access, Microsoft Corp, Redmond, WA). All statistical analyses were completed using commercially available software (SPSS v.22, IBM Corp., Armonk, NY). All study data was evaluated descriptively and data normality or skewness was verified for all ordinal or continuous measures using graphical analyses. Postoperative scores were operationalized using last available SNOT-22 responses due to known statistical stability, between 6-month and 18-month follow-up, of postoperative scores in the psychological domain[27].

Scoring differences over time were compared using either matched pairing t-tests for continuous variables or Wilcoxon signed rank testing for ordinal scores, while independent t-testing was utilized to compare mean psychological domain scores between independent groups. Significant differences in the frequency (%) of psychological symptoms over time were compared using McNemar's chi-square ($\chi 2$) testing. To account for individual variation in preoperative symptom status, relative mean improvements (RMI) were calculated for each symptom score using the algorithm: [(postoperative score – preoperative score) /preoperative score] X 100. All comparisons were reported using a Type I error probability (p-value) at the 0.050 level of significance.

RESULTS

Preliminary enrollment consisted of 550 study participants that completed all enrollment procedures and received ESS between March, 2011 and February, 2015. Additional exclusion criteria eliminated participants with ciliary dyskinesia/cystic fibrosis (n=23) and 40 participants with corticosteroid dependent conditions (sinusitis, n=14; asthma, n=19; other, n=7). A total of 374 (77%) participants were selected for final analysis after removal of subjects without a minimum of 6-month follow-up. Final cohort characteristics and preoperative measures of disease severity are shown in Table 2 while the prevalence of each surgical procedure type is described in Table 3. No significant differences ($p>0.050$) were found for any preoperative characteristic between participants with and without follow-up with the exception of slightly higher mean age in participants with at least 6-month postoperative evaluations (46.6[13.2] vs. 51.8[15.2] years; $p<0.001$).

Preoperative Psychological Dysfunction

The seven component items of the psychological symptom domain of the SNOT-22 instrument are described in Table 4. Before surgical intervention, a total of 360 (97%) participants with follow-up reported some degree of severity in at least one psychological symptom. In general, symptoms associated with CRS with the worst severity were reported to be waking up tired, fatigue, and reduced productivity while fewer patients reported problems with being frustrated, saddened, or embarrassed by symptoms of CRS. On average, participants reported a preoperative PHQ-2 mean score of 1.6[1.6] with 94 (25%) who screened positive for depressive disorders by providing scores of 3 or greater.

Postoperative Improvement in Psychological Dysfunction

Study participants were followed for an average of 14.6[5.0] months after endoscopic sinus surgery. The average overall psychological domain score on the SNOT-22 improved from 15.9[8.2] to 8.5[8.4] (RMI=40%; $p<0.001$) while the prevalence of participants reporting impairment in at least one psychological symptom, of any severity, reduced significantly from 97% before ESS to 78% ($p<0.001$) postoperatively. The prevalence of participants describing postoperative psychological symptom severity is further described in Table 5. The percentage of participants reporting ‘no problem’ significantly increased for all psychological symptoms following sinus surgery ($p<0.001$).

Average scores for ‘waking up tired’ significantly improved postoperatively from 3.0[1.4] to 1.7[1.5] (RMI=23%; $p<0.001$) compared to significant improvement in mean ‘fatigue’ score (2.9[1.5] to 1.7[1.5]; RMI=25%; $p<0.001$), ‘reduced productivity’ score (2.6[1.5] to 1.3[1.4]; RMI=28%; $p<0.001$), ‘reduced concentration’ score (2.5[1.5] to 1.3[1.4]; RMI=27%; $p<0.001$), ‘frustrated/restless/irritable’ score (2.4[1.5] to 1.2[1.4]; RMI=27%; $p<0.001$), ‘sad’ score (1.4[1.5] to 0.7[1.2]; RMI=15%; $p<0.001$) and ‘embarrassed’ scores (1.1[1.4] to 0.6[1.2]; RMI=8%; $p<0.001$).

To provide more comprehensive data for future patient counseling, preoperative and postoperative symptom severity was also evaluated to quantify the percentages of participants who report experiencing any improvement in psychological symptoms, any worsening of symptoms, or no change in symptoms corresponding to the smallest discernible change in Likert scale score responses (≥1 score unit; Table 6). The majority of patients (64–66%) reported experiencing at least minimal improvement in tiredness, fatigue, productivity, concentration, and frustration, restlessness, or irritability.

Study Cohort Subgroup Comparisons

Variation in postoperative improvement in psychological domain scores of the SNOT-22 was evaluated across clinical phenotypes including participants with and without a positive PHQ-2 screen for depressive disorder, nasal polyposis, and a previous history of endoscopic sinus surgery. Highly significant improvement was reported in mean psychological domain scores (Table 7) across all three clinical phenotypes with no significant difference in RMI values between any between subgroup comparisons ($p\geq0.073$). No differences in preoperative ($t=1.07$; $p=0.285$) or postoperative ($t=1.10$; $p=0.273$) psychological domain scores were reported between patients with and without nasal polyposis. However, patients

with a positive screen for depressive disorders reported significantly worse preoperative (t= −9.73; p<0.001) and postoperative (t= −7.28; p<0.001) psychological domain scores on average compared to patients without a positive screening score. Likewise, patients with a history of prior sinus surgery reported significantly worse preoperative (t= −2.50; p=0.013) and postoperative (t= −3.69; p<0.001) mean psychological domain scores compared to patients without a history of previous sinus surgery.

DISCUSSION

Following surgery, the mean total psychological domain score improved by 40%, with a significant reduction of patients reporting at least one psychological symptom from 97% before ESS to 78% postoperatively. Despite this significant improvement, symptoms of psychological dysfunction persist among the majority of patients undergoing ESS, with the least improvement in psychological symptoms of “sad” and “embarrassed”. Likewise, subgroup analysis of patients with previous ESS and a positive screen for depressive disorders found worse preoperative and postoperative psychological domain scores. In contrast to prior study by Browne et al., no significant difference was found between baseline psychological dysfunction scores among patients with and without nasal polyposis.[11] Among patients included in this study, ~25% screened positive for depressive disorders, which is consistent with recently published studies by Tomoum et al. and Davis et al.[4,9]

Several studies have linked comorbid depression and anxiety with increased baseline disease-specific QOL impairment, as measured by the CSS[28], RSDI[4,28] and SNOT-20[29] PROMs. Consistent with the findings of this study, several reports have found comparable postoperative improvements in total QOL scores among groups with and without psychological dysfunction[7,9,28], while others have demonstrated decreased postoperative improvements among patients with comorbid depression.[30] The influence of various discrete symptoms of psychological dysfunction on treatment outcomes has not been previously described.

The significance of these results are difficult to assimilate with published findings due to the dearth of literature surrounding specific symptom reporting of psychological dysfunction in CRS. Neither a minimal threshold score for a positive diagnosis of psychological dysfunction, nor a minimal clinically important difference, have been defined for the psychological domain of the SNOT-22 instrument to date. These inherent boundaries do not allow for prevalence data reporting while limiting postoperative evaluations to relative change in mean symptom scores (ie. RMI values). Despite significant post-operative improvements, the elevated prevalence of symptoms of psychological dysfunction following ESS underscores the difficulties in treating patients with recalcitrant CRS. Causes for persistent psychological dysfunction are likely multi-factorial, and include persistent sinonasal inflammation, unmeasured patient factors including healthcare satisfaction, postoperative response shifts, and comorbid psychological factors such as undiagnosed anxiety and depressive disorders. Preoperative screening of undiagnosed psychological disorders may aid in identifying these patients, allowing for improved patient counseling and psychology/psychiatry referral and initiation of complementary therapies. Further,

preoperative use of the SNOT-22 can be used to guide patient counseling and set reasonable postoperative expectations. For example, a patient who identifies reduced productivity as their most important symptom could be counseled that approximately 2/3rds of patients will notice clinically meaningful symptom improvement.

A number of caveats exist when interpreting the findings from this study. The predetermined response options of Likert scale scores of the SNOT-22 survey items contain inherent limitations in patient discernibility and may not accurately quantify the full spectrum of psychological symptom severity. Additionally, individual scale items of the SNOT-22 have not been validated for independent use in patients with CRS. . In fact, some evidence of survey scale “basement effects” was evident with certain postoperative response (Table 5) frequencies.

This investigation is supported by a prospective design and robust sample size, however the lack of an internal control group/cohort does introduce the potential for reportable postoperative improvements due to patient expectation or a natural history of psychological symptom progression unrelated to surgical intervention. The consistency of effect found across all 7 psychological symptoms however does support some causal relationship to surgical intervention. Due to the observational nature of the study, the fact that surgical extent subgroups were not independent, and that no overall consensus has defined levels of surgical exposure for this population, we did not evaluate differences in psychological symptom improvement across types or extent of sinus surgery. This investigation is further bolstered by multi-centered enrollment, however further external validity to patient populations outside academic, rhinology practices is required and the results reported here may not be applicable to dissimilar patient groups.

CONCLUSIONS

Mental health-related symptoms are highly prevalent among patients with CRS and significantly improve following ESS. Despite these improvements, some degree of persistent postoperative psychological dysfunction was reported. Further study is necessary to determine which factors are associated with persistent psychological dysfunction after ESS in order to optimize treatment outcomes.

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Table 1

Symptom domains of the SNOT-22 survey instrument with component survey items

Symptom domains:	Score range:	Component items:
Rhinologic symptoms	0–30	#1, 2, 3, 6, 21, 22
Extra-nasal rhinologic symptoms	0–15	#4, 5, 6
Ear /facial symptoms	0–25	#2, 7, 8, 9, 10
Psychological symptoms	**0 – 35**	**#14, 15, 16, 17, 18, 19, 20**
Sleep dysfunction symptoms	0–25	#11, 12, 13, 14, 15

Table 2

Cohort characteristics and clinical measures of disease severity (n=374)

Preoperative characteristics:	Mean [SD]	Range: [LL - UL]	N (%)
Age (years)	51.8 [15.3]	18 –86	
Male			177 (47%)
Caucasian			317 (85%)
African American			16 (4%)
Asian			17 (5%)
Hispanic /Latino			22 (6%)
Current tobacco use			18 (5%)
Alcohol consumption			159 (43%)
Asthma			136 (36%)
Allergy (mRAST / skin prick)			163 (44%)
Nasal polyposis			137 (37%)
Previous endoscopic sinus surgery			201 (54%)
Aspirin sensitivity			39 (8%)
Septal deviation			152 (41%)
Turbinate hypertrophy			61 (16%)
Fibromyalgia			16 (4%)
Diabetes mellitus (Type I or II)			25 (7%)
CT staging score	12.0 [6.1]	0–24	
Endoscopy staging score	6.0 [3.8]	0 –18	

SD, standard deviation; LL, lower limit; UL, upper limit; mRAST, modified radioallergosorbent testing; CT, computed tomography

Table 3

Frequency of unilateral and bilateral surgical procedures (n=374)

Surgical procedures:	**Left side N (%)**	**Right side N (%)**
Maxillary antrostomy	340 (91%)	332 (89%)
Partial ethmoidectomy	49 (13%)	48 (113%)
Total ethmoidectomy	285 (76%)	282 (75%)
Sphenoidotomy	256 (68%)	257 (69%)
Middle turbinate resection	44 (12%)	49 (13%)
Inferior turbinate reduction	76 (20%)	73 (20%)
Frontal sinusotomy *Draf* I	33 (9%)	30 (8%)
Frontal sinusotomy *Draf* IIa	184 (49%)	184 (49%)
Frontal sinusotomy *Draf* IIb	28 (8%)	29 (8%)
Frontal sinusotomy *Draf* III *	7 (2%)	
Septoplasty	155 (41%)	
Image guidance	255 (68%)	

*bilateral by definition

Table 4

Prevalence of participants describing preoperative psychological symptom severity on the SNOT-22 instrument (n=374)

	Preoperative Responses:					
Psychological symptoms:	**"No problem" N(%)**	**"Very mild problem" N(%)**	**"Mild or slight problem" N(%)**	**"Moderate problem" N(%)**	**"Severe problem" N(%)**	**"Problem as bad as it can be" N(%)**
"Waking up tired"	33 (9%)	29 (8%)	61 (16%)	101 (27%)	96 (26%)	53 (14%)
"Fatigue"	35 (9%)	32 (9%)	59 (16%)	99 (27%)	100 (27%)	48 (13%)
"Reduced productivity"	46 (12%)	51 (14%)	61 (16%)	102 (27%)	80 (21%)	33 (9%)
"Reduced concentration"	52 (14%)	44 (12%)	80 (21%)	89 (24%)	81 (22%)	27 (7%)
"Frustrated/restless/irritable"	55 (15%)	57 (15%)	67 (18%)	93 (25%)	72 (19%)	29 (8%)
"Sad"	142 (38%)	73 (20%)	63 (17%)	57 (15%)	27 (7%)	11 (3%)
"Embarrassed"	187 (50%)	65 (17%)	52 (14%)	38 (10%)	24 (6%)	7 (2%)

SNOT-22, 22-item SinoNasal Outcome Test

Int Forum Allergy Rhinol. Author manuscript; available in PMC 2017 September 01.

Table 5

Prevalence of participants describing postoperative psychological symptom severity on the SNOT-22 instrument (n=374)

	Postoperative Responses:					
Psychological symptoms:	**"No problem" N(%)**	**"Very mild problem" N(%)**	**"Mild or slight problem" N(%)**	**"Moderate problem" N(%)**	**"Severe problem" N(%)**	**"Problem as bad as it can be" N(%)**
"Waking up tired"	108 (29%)	81 (22%)	54 (14%)	74 (20%)	42 (11%)	15 (4%)
"Fatigue"	120 (32%)	68 (18%)	67 (18%)	70 (19%)	35 (9%)	14 (4%)
"Reduced productivity"	160 (43%)	69 (18%)	55 (15%)	53 (14%)	28 (8%)	9 (2%)
"Reduced concentration"	161 (43%)	71 (19%)	55 (15%)	53 (14%)	25 (7%)	9 (2%)
"Frustrated / restless / irritable"	172 (46%)	79 (21%)	44 (12%)	46 (12%)	23 (6%)	10 (3%)
"Sad"	241 (64%)	62 (17%)	32 (9%)	17 (5%)	17 (5%)	5 (1%)
"Embarrassed"	273 (73%)	46 (12%)	16 (4%)	21 (6%)	14 (4%)	4 (1%)

SNOT-22, 22-item SinoNasal Outcome Test

Table 6

Frequency of participants who reported postoperative improvement, worsening, or no change of psychological symptom severity following endoscopic sinus surgery

Psychological symptoms:	Postoperative Improvement N(%)	Postoperative Worsening N(%)	No Change Postoperatively N(%)
"Waking up tired"	242 (65%)	37 (10%)	94 (25%)
"Fatigue"	243 (65%)	34 (9%)	96 (26%)
"Reduced productivity"	247 (66%)	35 (9%)	91 (24%)
"Reduced concentration"	239 (64%)	32 (9%)	102 (27%)
"Frustrated / restless /irritable"	244 (65%)	41 (11%)	88 (24%)
"Sad"	173 (46%)	45 (12%)	155 (41%)
"Embarrassed"	140 (38%)	46 (12%)	187 (50%)

Table 7

Mean postoperative improvement in psychological domain scores of the SNOT-22 in participants with and without clinical phenotypes (n=374)

Subgrouping-	Preoperative	Postoperative	Δ			
Depressive disorder:	**Mean[SD]**	**Mean[SD]**	**Mean[SD]**	**95% CI**	**RMI**	**p- value**
With	22.3[6.6]	13.7[10.0]	−8.6[9.8]	(−6.6, −10.6)	38%	<0.001
Without	13.8[7.5]	6.8[7.0]	−6.9[7.7]	(−6.0, −7.9)	41%	<0.001
Nasal polyposis:						
With	15.3[8.1]	7.9[8.1]	−7.4[8.6]	(−5.9, −8.9)	43%	<0.001
Without	16.3[8.2]	8.9[8.5]	−7.3[8.1]	(−6.3, −8.4)	39%	<0.001
History of prior sinus surgery:						
With	16.9[8.2]	10.0[8.9]	−6.8[8.6]	(−5.7, −8.1)	35%	<0.001
Without	14.8[8.0]	6.8[7.3]	−7.9[8.0]	(−6.7, −9.1)	47%	<0.001

SD, standard deviation; RMI, relative mean improvement; Δ (delta), postoperative change; CI, confidence interval of the mean improvement score