



Improvement in Nasal Obstruction and Quality of Life after Nasal Septoplasty with Turbinoplasty: A Pre- and Post-study

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Abstract

Introduction Septoplasty and turbinoplasty are common surgical interventions used to relieve nasal obstructive symptoms. Since it is difficult to measure the degree of nasal blockage, current literature wonders about the frequent performance of these procedures.

Objective To evaluate the perceived change in the nasal obstruction and the quality of life (QoL) of patients that underwent a septoplasty along with a turbinoplasty by applying subjective scales, to describe the correlation between those scales, and to study the impact of clinical factors in the postoperative outcomes.

Methods Prospective observational study. The Nasal Obstruction Symptom Evaluation (NOSE), the Visual Analog Scale (VAS), and the Glasgow Benefit Inventory (GBI) were assessed. The paired sample Wilcoxon test was used to evaluate the difference between the pre- and postoperative surveys. The correlation coefficient between the subjective scales was calculated. A quantile regression was performed to evaluate the effect of surgery on the results adjusted for clinical and demographic variables.

Results A total of 115 patients were interviewed. Postoperative NOSE scores were 45 points lower (95% confidence interval [CI]: - 53.53– 35.46; $p < 0.001$) in comparison with the NOSE preoperative scores. Obesity was the only statistically significant factor associated with worse outcomes. Additionally, we found a high correlation between the NOSE and VAS scores and a negative correlation between the GBI and postoperative VAS scores.

Conclusion Nasal septoplasty, when paired with a turbinoplasty, decreases nasal obstruction and improves QoL. Obesity was associated with worse results. There was a strong correlation between the NOSE and the VAS results and between the GBI and postoperative VAS results.

Keywords

- ▶ nasal obstruction
- ▶ nasal septum
- ▶ nasal surgical procedures
- ▶ quality of life
- ▶ visual analogue scale

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Introduction

Nasal blockage is a common complaint in otolaryngology outpatient clinics.¹ It can be a consequence of many factors, such as septal deviation and allergic rhinitis.² Septoplasty combined with turbinoplasty is frequently chosen as a treatment to relieve symptoms when other medical treatments have failed.³

The subjective evaluation of a nasal obstruction can be performed using scales such as the Nasal Obstruction Symptom Evaluation (NOSE) and the Visual Analogue Scale (VAS).³ Nasal obstruction can be responsible for other symptoms including snoring, diurnal somnolence, and fatigue, which may lead to deterioration of the patient's quality of life (QoL).⁴ There have been few published studies concerning the impact of these surgeries on QoL and the correlation between the various subjective measures used to evaluate nasal obstruction.⁵ Moreover, factors like poor QoL before surgery, quality of sleep, and psychological factors may alter QoL perception in these patients.⁶

The correlation between objective measures and the subjective perception of nasal obstruction is reasonably good.^{7–12} However, some patients persist with symptoms despite surgery even when nasal permeability improvement has been demonstrated by objective measures.

Currently, there is a poor consensus in our country about the utility of subjective measures of nasal obstruction and the correlation between them. Due to the complexity of the nasal obstruction, there is a lack of diagnostic tools available to objectively predict postoperative outcomes after septoplasty plus turbinoplasty. Still, subjective measures are very valuable because the perspectives and satisfaction of the patients can give us information about the effectiveness of treatment.¹³

To our knowledge, there is no literature in Colombia about the utility of septoplasty and turbinoplasty nor research about the main associated factors that could influence the postoperative outcomes. The aim of the present study was to evaluate the change, after septoplasty and turbinoplasty, in the patients' nasal obstruction perception and QoL, through validated subjective scales: the VAS, the NOSE and the Glasgow Benefit Inventory (GBI). Moreover, to describe the correlation between those scales and the effect of clinical factors like smoking, body mass index (BMI), age, and allergic rhinitis in surgery results.

Materials and methods

Study design

A prospective study was conducted. It was approved by the ethics committee (CCEI-8616–2017).

Patients

The participants in our study were patients over 18 years old at two institutions whose nasal obstructions due to septal deviation were managed with primary septoplasty paired with turbinoplasty between January 2017 and December 2018. Septal deviation was diagnosed during an otolar-

ngology physical examination or an endoscopic examination after decongestion by an ear nose and throat (ENT) specialist. Also, ENT specialists diagnosed allergic rhinitis based on symptoms and on the allergic rhinitis and its impact on asthma (ARIA) classification.¹⁴ Patients with other causes of nasal obstruction such as nasal polyps, sinusitis, septal perforation, recent nasal trauma, sinonasal tumors and nasal valve stenosis were excluded.

Surgical procedure

All procedures were performed by different ENT specialists and residents. A hemitransfixion incision was performed followed by mucoperichondrium elevation in one side and excision of the posteroinferior septal cartilage. Then, elevation of the mucoperichondrium on the other side was performed, followed by excision of the deviated portion and repositioning of the excised cartilage. We also performed an inferior turbinate lateralization followed by a submucosal electrocautery ablation along with the head, tail, and body of the inferior turbinate.

Outcomes measures

Information concerning age, gender, weight, height, smoking status, and presence of allergic rhinitis was collected. Both nasal obstruction scales, the NOSE scale (validated in Spanish by Larrosa et al.)¹⁵ and the VAS scale, were applied before and 6 to 26 months after surgery; the GBI scale was applied during the same timeframe after surgery. The scales were applied by an otolaryngology resident by telephone call or during postoperative consultation follow-up. The NOSE scale ranges from 0 to 100 (15–25 = mild; 30–50 = moderate; 55–75 = severe, and > 80 = extreme obstruction), and the VAS scale ranges from 0 (no nasal obstruction) to 10 (complete nasal obstruction).¹⁶

The GBI was used as a scale to assess QoL, which is sensitive to change after an otolaryngology surgery. The GBI is an 18-item postintervention survey, which is divided into 3 domains: General Benefit (12 questions), Social Support (3 questions), and Physical Health (3 questions). It results in a score ranging from - 100 (negative benefit) to + 100 (positive benefit) with a score of 0 equaling to no benefit.¹⁷

Statistical analysis

Statistical analyses were performed using Stata 16 MP (StataCorp LLC., College Station, Texas, United States) and R 3.6.1 (A Language and Environment for Statistical Computing, Vienna, Austria). Descriptive analysis of the data was done by calculating the absolute and relative frequencies for qualitative variables, and central tendency and dispersion measures were analyzed for quantitative variables.

Bivariate analyses between pre- and postsurgery data for the NOSE and VAS scales were analyzed by the paired samples Wilcoxon test. On the other hand, quantile regression was performed to evaluate the effect of surgery on the septoplasty results measured through the NOSE scale, which had been adjusted for some clinical and demographic variables. Additionally, the Spearman correlation coefficient was calculated to check the correlation between the GBI and the

Table 1 Baseline demographic and clinical characteristics of the participants

Characteristic (n = 115)	n	%
Gender, f/m	33/82	28.7/71.3
Age (years old) ^a	41.94 (14.44)	41.83 (30.17–52.27)
Age group (years old)		
< 20	12	10.43
20–40	43	37.39
40–60	48	41.74
> 60	12	10.43
Follow-up time (months) ^a	9.46 (3.50)	9.06 (6.94–10.87)
History and comorbidities		
Smoking	13	11.30
Allergic Rhinitis	49	42.61
Height (meters) ^a	1.69 (0.09)	1.68 (1.62–1.75)
Weight (kilograms) ^a	75.56 (12.7)	75 (67–84)
BMI (kg/m ²) ^a	26.77 (4.13)	26.22 (23.81–29.41)
BMI categories		
Underweight	1	0.87
Normal (healthy weight)	45	39.13
Overweight	41	35.65
Obese	26	22.61
No data	2	1.74

Abbreviations: BMI, body mass index; F, female; M, male

^aValues are expressed in Mean (standard deviation) and Median (Interquartile Range)

pre- and postsurgical scores from the NOSE and VAS scales. A statistical significance of $p < 0.05$ was defined a priori.

Results

The present study enrolled 115 patients, 82 (71%) males and 33 females (29%). The mean age was 42 ± 14 years old. The demographic data of the patients are shown in **Table 1**. Ninety-four patients completed the 6-to-26 month follow up surveys (VAS and NOSE), and they were included in the pre- and postoperative analysis. Postoperative surveys were completed in a mean of 9.46 months (6 to 26), as shown in **Table 1**.

After surgery, in the NOSE scale, 70% and 50% of the patients had scores less than 40 and 17 respectively. Regarding the VAS scale, 50% of the patients had scores less than 2, and 75% scored less than 5. A general decrease of the median NOSE and VAS scores was observed in patients who had undergone a septoplasty along with a turbinoplasty (48 points and 5 points, respectively) ($p < 0.001$) (**Table 2**).

The box and whisker plot offers a detailed overview of the pre-post NOSE and VAS by age groups and BMI. The box represents the 25th and 75th percentiles and the whiskers are the upper and lower ranges of pre-post NOSE and pre-post

Table 2 Pre- and postoperative NOSE and VAS scores

Surveys (n = 94)	Median preoperative (IQR)	Median postoperative (IQR)	p-value ^a
NOSE	65 (50–80)	17 (5–40)	< 0.001
VAS	7 (6–8)	2 (1–5)	< 0.001

Abbreviations: NOSE, nasal obstruction symptom evaluation; IQR, interquartile range (p25-p75); VAS, visual analogue scale.

^ap-value based in a paired sample Wilcoxon test

VAS by age groups and BMI (**Fig. 1**). A general decrease in the NOSE and VAS scores in all age ranges and BMI categories after surgery is graphically evidenced. There is a slight increase in the difference between the pre- and post-NOSE medians in the age group under 20 years old, suggesting that this age group would have a better outcome after surgery (55 points versus 45, 47, and 52 points for the groups between 21 and 40 years old, between 41 and 60 years old, older than 60 years, respectively).

On the other hand, patients aged up to 60 years old had a greater reduction in nasal obstruction after surgery according to the VAS scale. In this group, the VAS median decreased 6.5 points compared with the preoperative VAS median. Regarding the BMI, a decrease is observed in both: NOSE and VAS postoperative scores in a similar amount among all the BMI groups.

To assess the QoL, the GBI test was administered to 109 patients; 91% of the patients reported improvement in the total GBI score (including the 3 domains); 91% reported improvement in the General Benefit domain, 73% reported improvement in Social Support and 60% stated experiencing an improvement in Physical Health (**Table 3**).

Patients under 20 years old and over 60 years old had a score ≥ 0 in all the GBI domains. On the other hand, some of the patients between 21 to 60 years old had a negative benefit in all the domains, especially in the Social Support and Physical Health domains (**Annex 1 online**). Regarding the BMI, normal weight patients had the highest scores or greater benefit in all the GBI domains. In contrast, even though most obese and overweight patients had a positive benefit, they reached the lowest scores (negative benefit) in the General Benefit and Physical Health domains (**Annex 1 online 1**).

Bivariate and multivariate quantile regression analyses were performed. A decrease of 45 points was observed (coefficient of - 45 points; 95% confidence interval [CI]: - 53.53--35.46; $p < 0.001$) in the postoperative NOSE score (after septoplasty and turbinoplasty) in comparison with the preoperative score after adjusting for possible confounders, as seen in **Table 4**. Obesity was associated with the worst results in the postoperative bivariate NOSE score and was still found to be significant after adjusting for other variables (coefficient of 15 points; 95%CI: 2.04–28.2; $p = 0.02$).

Fig. 2 shows the calculated correlations in the correlation matrix. Numerical correlations were observed in the lower left area; there is a strong correlation between

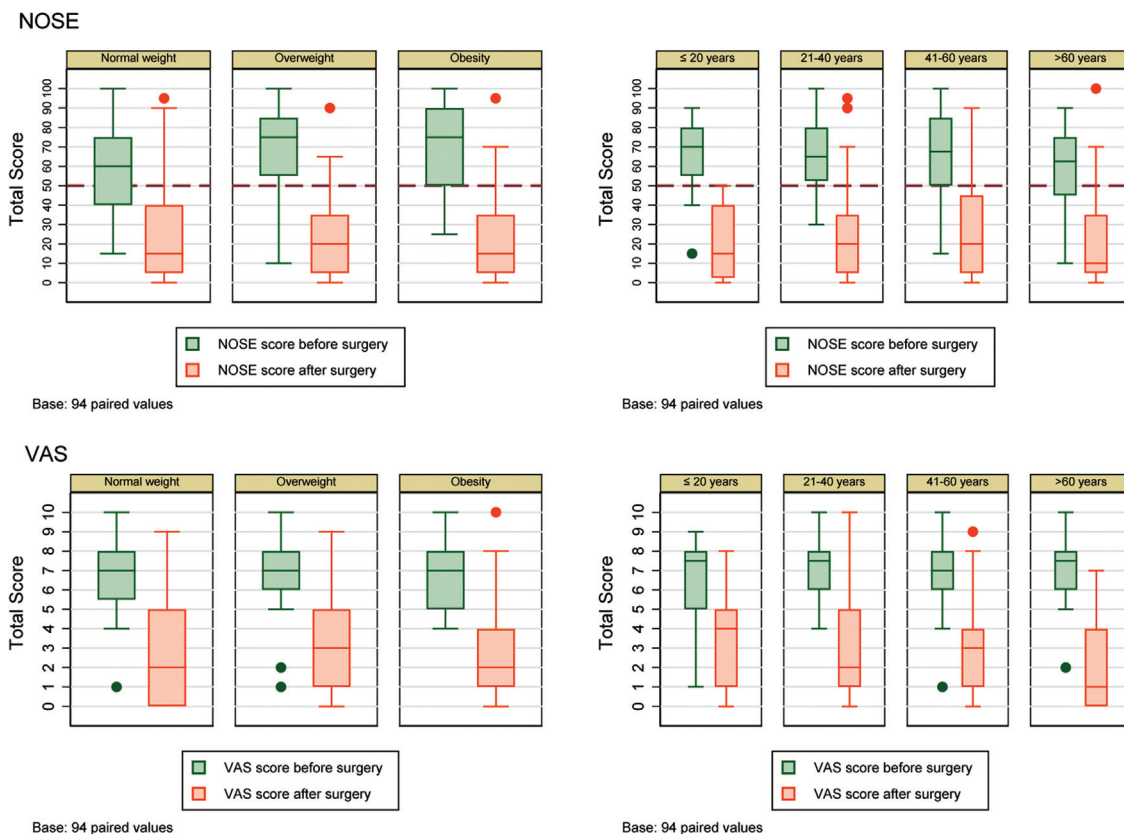


Fig. 1 Box and whisker plot of the pre-post NOSE and pre-post VAS by age groups and BMI

Table 3 Description of results regarding quality of life as measured by the Glasgow Benefit Inventory

GBI Subscales ^a	Median (IQR) ^b	n ^c	% ^c
General benefit	25 (16.66–45.83)	99	90.83
Social support	33.33 (0–50)	80	73.39
Physical health	16.66 (0–33.33)	65	59.63
Total GBI	25 (13.88–44.44)	99	90.83

Abbreviation: GBI, Glasgow Benefit Inventory.

^an = 109 participants without missing data

^bSummary measures of the scores for each of the domains and the total of the scale, interquartile range: (p25-p75)

^cAbsolute and relative frequencies of participants who showed improvement in the domains of the scale

preoperative NOSE and preoperative VAS scores ($\rho = 0.67$; 95%CI: 0.55–0.77; $p < 0.001$) and between postoperative NOSE and postoperative VAS results ($\rho = 0.75$; 95%CI: 0.65–0.82; $p < 0.001$). Moreover, there is a strong negative correlation between postoperative NOSE results and total GBI score ($\rho = -0.43$; 95%CI - 0.571-- 0.26; $p < 0.001$), as well as between postoperative VAS results and total GBI score ($\rho = -0.58$; 95%CI: - 0.69-- 0.44; $p < 0.001$). This means that the less nasal obstruction, the better the QoL. However, there is no correlation between GBI domains and total GBI scores with preoperative NOSE and VAS scales.

Additionally, there is a negative correlation between postoperative NOSE and VAS scales and GBI domains: General Benefit and postoperative VAS ($\rho = -0.60$; 95%CI: - 0.70-- 0.46; $p < 0.001$), General Benefit and postoperative NOSE ($\rho = -0.45$; 95%CI: - 0.58-- 0.28; $p < 0.001$), Social Support and postoperative VAS ($\rho = -0.44$; 95%CI: - 0.57-- 0.27; $p = 0.0018$), Social Support and postoperative NOSE ($\rho = -0.29$; 95%CI: - 0.44-- 0.10; $p < 0.001$), Physical Health and postoperative VAS ($\rho = -0.39$; 95%CI: - 0.54-- 0.22; $p < 0.001$), and Physical Health and postoperative NOSE ($\rho = -0.32$; 95%CI: - 0.48-- 0.141; $p = 0.0009$) (**► Fig. 2**).

The upper area, in **► Fig. 2**, correlations are shown graphically; the size of the spheres represents the correlation strength between scales, while the blue and red colors represent positive and negative correlations, respectively. There is a strong negative correlation between the postoperative VAS scale and Total GBI and its General Benefit domain. There is no significant correlation between preoperative NOSE and VAS scales and the Total GBI or its domains. Moreover, there is a strong, positive correlation between preoperative and postoperative NOSE and VAS scales.

Discussion

Septoplasty and turbinoplasty are procedures frequently performed by an otorhinolaryngologist to correct nasal

Table 4 Associations between sociodemographic and clinical variables with NOSE scores after surgery according to bivariate and multivariate quantile regression

Variable	Bivariate model ^b		Multivariate model ^b	
	β^a	95%CI	β^a	95%CI
Time				
Post-NOSE score (versus pre-NOSE score)	- 45	(- 53.44--36.55)	- 45	(- 53.53--35.46)
Age	0.22	(- 0.25-0.69)	-0.20	(- 0.61-0.21)
Gender				
Female (versus male)	10	(- 4.34-24.34)	-2.76	(- 15.39-9.87)
BMI				
Overweight (versus normal weight)	10	(- 6.91-26.91)	5.30	(- 7.19-17.81)
Obese (versus normal weight)	10	(- 8.27-28.27)	15.14	(2.04-28.23)
Allergic rhinitis				
Yes (versus not)	10	(- 2.81-22.81)	6.60	(- 5.34-18.55)
Smoking				
Yes (versus not)	- 5	(- 25.54-15.54)	0.80	(- 13.67-15.27)
Follow- up time	0.001	(- 2.02-2.02)	0.79	(- 0.66-2.25)

Abbreviations: BMI, body mass index; CI, confidence interval.

^a β : Quantile coefficient regression

^bLog-likelihood Model: - 790.907; AIC: 1601.815; $n = 175$

obstruction in patients with septum deviation and inferior turbinate hypertrophy.¹ Nowadays, the objective methods to evaluate nasal obstruction, such as rhinomanometry, are not fully consistent with the patient's perception of nasal obstruction given the complexity of its pathophysiology. This makes it difficult to identify patients who benefit from surgery, and this results in unsatisfactory postsurgical outcomes.

Our study focuses exclusively on subjective measurement scales, which we consider to be easier to use during ENT daily clinical practice. These scales should be considered to choose a better target population and to improve counseling regarding expectations after surgery.

Current studies show that septoplasty paired with turbinoplasty improves nasal obstructive symptoms in the short-medium term, independent of the age and weight of the patient. All our patients met the inclusion criterion (septal deviation), which was the reason for performing septoplasty on them; however, all of them needed the turbinoplasty to be performed due to some degree of hypertrophy of the turbinate. Consequently, it was difficult to measure the impact of solely septoplasty or turbinoplasty in the nasal obstruction improvement.

There was a statistically significant difference between pre- and postoperative values of the NOSE and the VAS ($p < 0.001$) scales in the bivariate analysis and in the multivariate analysis, with a difference of 45 points less in the postsurgical NOSE score ($p < 0.001$). This correlates with previously published studies.¹⁸⁻²⁰ Dinesh Kumar et al. used the NOSE score for subjective evaluation, and they reported a 70-point NOSE score reduction after septoplasty and turbinoplasty in comparison with preoperative NOSE scores.²¹ A pilot study was performed by Corredor-Rojas et al. in 2017 in one of the institutions included in the present

study. Similarly, in that study, nasal obstruction was measured through the NOSE and VAS scales and QoL through the GBI test, but just during a postoperative midterm period. Corredor-Rojas et al. reported that 75% of the patients in their study scored below 50 in the postsurgical NOSE and below 6 on the VAS score; both results are consistent with postoperative nasal obstruction relief. Moreover, confounding factors were suggested, and that is why variables like allergic rhinitis and BMI are considered now.²²

Regarding the GBI scale, 90% of the patients reported an improvement in QoL, mainly in the General Health domain. However, the P75 of the total GBI was 44, indicating that only 25% of the patients managed to reach a benefit score that exceeded 45 points out of 100 points, which is the maximum score. While it should be noted that it is a score that indicates improvement, it is not substantially positive. As previously stated, Corredor-Rojas et al. used the GBI scale in a similar context; they found the percentage of the population with an improvement in the total GBI to be 76.79%, with the General Health domain also showing the most improvement (78.57%). Compared with our results, we observed a greater global postoperative benefit, which could be explained by the difference in sample size.

This may lead us to think that nasal permeability does impact QoL. However, septum deviation may not be the main cause of patient discontent in our population, and other factors influence this perception, such as the emotional state of the patient. This is described by Valsamidis et al., who established that there is an association between high rates of presurgical stress and low scores on the postsurgical GBI.¹⁹ For this reason, it is worth highlighting the importance of explaining to patients the complexity of their condition and the surgical procedure to reduce their anxiety levels as much

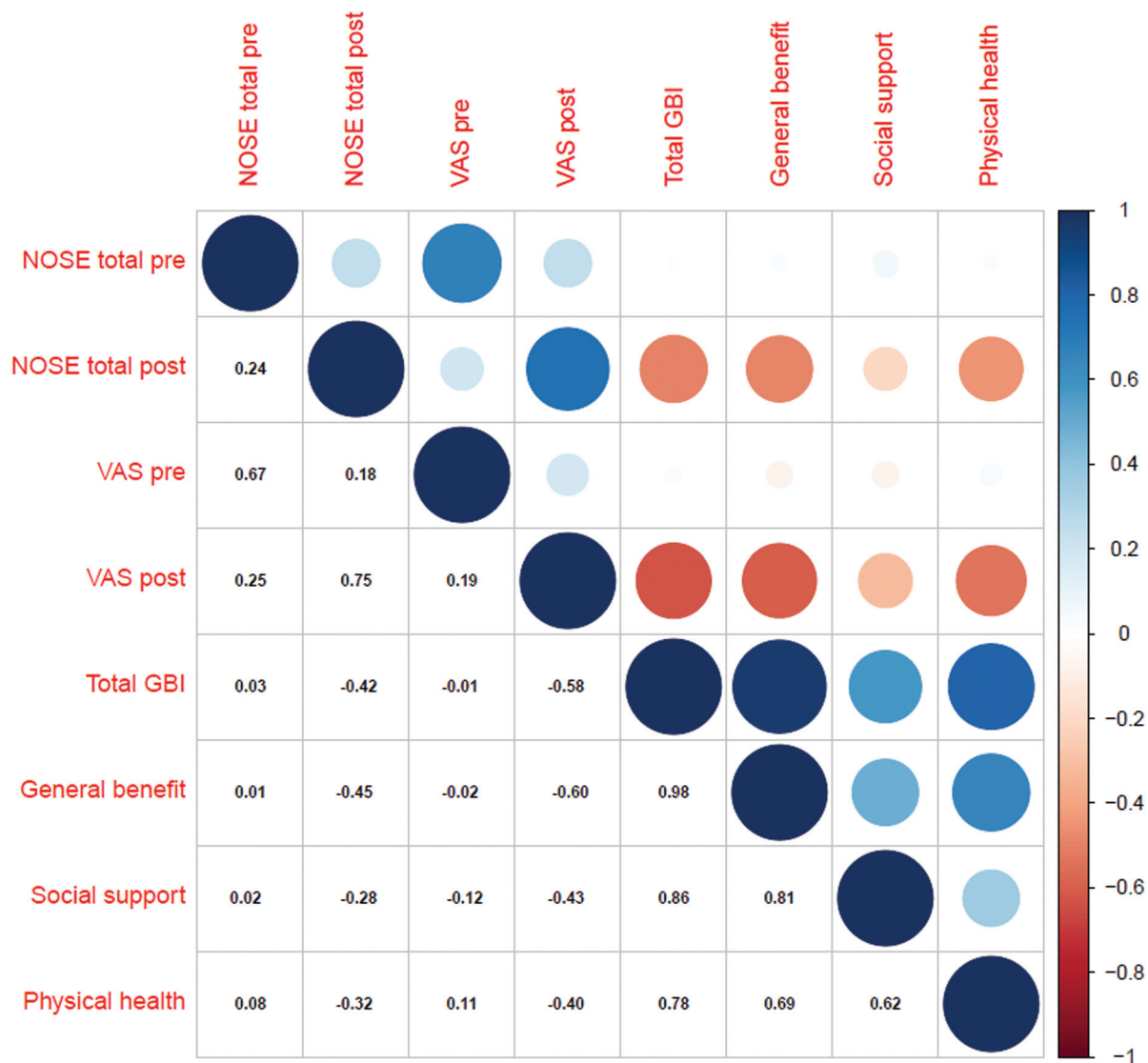


Fig. 2 Nasal obstructive subjective scales (NOSE and VAS) and the Glasgow Benefit Inventory (GBI) correlation matrix

as possible and clarify the expected results after the medical and surgical treatment is performed.

There are very few studies on the correlation between different subjective measures.¹⁹ Our correlation analysis revealed that the postsurgical values in the NOSE and VAS have a negative correlation with the GBI scale results with a $\rho = -0.49$ and -0.58 ($p < 0.001$), respectively. These findings are similar to those reported by Uppal et al.,²³ who found a correlation between the GBI and subjective nasal obstruction ($\rho = 0.61$, $p < 0.01$). Additionally, in our results, the postsurgical VAS scores correlate more strongly with the GBI and its subscales; moreover, the association between the VAS and the NOSE results is also strong ($\rho = 0.7$; $p < 0.01$). Lara-Sánchez et al. found a good correlation between NOSE and VAS results ($\rho = 0.83327$) from a cohort of 102 patients. This suggests that either scale can be used to measure the degree of nasal obstruction.²⁴ We recommend the VAS as a useful tool because it is easy to administer and scores can be obtained quickly; in addition, it correlates very well with

the nasal symptoms and with the satisfaction of the patient in terms of QoL.

Other authors have stated that the coexistence of allergic rhinitis with septal deviation is associated with poor postsurgical results since these patients have more postsurgical edema and discomfort.²⁵ It is also likely that, in some cases, nasal obstructive symptoms are caused mainly by allergic rhinitis and not by septal deviation. Our findings differ somewhat regarding this, given that despite having a high prevalence of allergic rhinitis based on symptoms in our sample (42%), this is not a predictive factor of the short-medium term postsurgical nasal obstruction outcomes. Neither smoking, gender, nor age were statistically significant factors influencing postsurgical results.

On the other hand, in our sample, obese patients experienced less nasal obstruction improvement after surgery compared with normal weight and overweight patients. Obesity adds 15 points (95%CI: 2.04–28.23) to the postsurgical NOSE. However, this analysis showed a wide CI, so further

studies would be necessary to explore this association. Additionally, obese and overweight patients had the lowest negative benefit in the General Benefit and Physical Health domains.

Obesity is an energy-rich condition, and it activates inflammatory pathways in the metabolically active organs such as the liver.²⁶ Therefore, it represents a hyperinflammatory state, and it can be linked to other inflammatory conditions such as allergic rhinitis and chronic rhinosinusitis. Obesity is also associated with a variety of comorbidities such as diabetes and cardiovascular disease. This represents one of the most important factors that influence the decrease in QOL of obese patients.^{26,27}

Bearing this in mind, we expect more nasal edema and postoperative nasal obstruction in these patients. This association was described by Steele et al., who reported less improvement in their obese participants (29%) on the Sino-nasal Outcomes Test-22 (SNOT-22) after sinus surgery compared with overweight and normal-weight participants (40% versus 48%, respectively).²⁸ Therefore, it is important to consider the expected outcomes in this population when deciding on surgical management; this association will require future investigation.

The present study has the advantage of being a prospective study, where we use validated scales to measure the parameters we wanted to analyze. In addition, the scales were applied by well-trained otolaryngologists and ENT residents. Among the limitations, it is worth mentioning the lack of a control group, the lack of allergy tests as part of the diagnosis of allergic rhinitis, lack of objective measures, and incomplete preoperative surveys of 22 patients that we could not include in the pre- and postanalysis. We could not collect information on the topical corticosteroid nasal treatment status nor the severity and location of the deviation.

Additionally, the time between the surgery and the postoperative follow-up lasted longer than expected in a few participants, 75% of the patients had the postoperative follow-up in <10 months, which represents a short-medium term follow-up. However, the follow-up time did not influence the outcomes, as shown in the bivariate and multivariate regression (95% CI: -0.66 -2.25; p. 0.28).

We believe that randomized controlled studies with a larger sample and longer follow-up time are required to identify which factors influence patient satisfaction and postoperative results and, thus, identify which patients benefit from surgical management.

Conclusions

The main benefit of septoplasty paired with turbinoplasty is the improvement of nasal obstructions. Although these procedures improve the QoL of patients, there may be other factors that influence and prevent the level of postsurgical satisfaction from being higher. Obesity is the strongest predictor of suboptimal outcomes after septoplasty and turbinoplasty in our patients. The decrease in nasal obstruction measured after surgery with the NOSE and VAS scales has a good correlation with patient satisfaction measured

with the GBI, and our results recommend the VAS as a valuable and convenient tool to use during the consultation to evaluate nasal obstruction and the level of satisfaction of patients after surgery.

Ethics approval and consent to participate
Ethical Committee approval (CCEI-8616-2017).

Availability of data and materials

Part of the data generated or analyzed during the present study is included in the present published article. Full datasets generated during and/or analyzed during the present study are available from the corresponding author on reasonable request.

Contributions of the authors

García-Chabur MA, the first author of the study, contributed to the data collection, database construction, and manuscript writing.

Castellanos J., Salgar M., and Corredor-Rojas G. performed part of the data collection and contributed to the English translation of the article.

Moreno S. performed the statistical analysis and supported and guided the statistical data interpretation.

Pinzón M. and Peñaranda A. provided support on part of the data collection. García-Chabur MA, Corredor-Rojas G, and Peñaranda A. were involved in the drafting of the manuscript. Peñaranda A. revised the manuscript critically for intellectual content. All authors read and approved the final manuscript for publication.

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Conflict of interests

The authors have no conflict of interests to declare.

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