11-3-2020

Predictors of Long-Term Nasal Obstruction Symptom Evaluation Score Stability Following Septoplasty With Inferior Turbinate Reduction

Richard H. Law

Talal D. Bazzi

Meredith Van Harn

John R. Craig

Robert H. Deeb

The Laryngoscope

Predictors of Long-Term Nasal Obstruction Symptom Evaluation Score Stability Following Septoplasty With Inferior Turbinate Reduction

Richard H. Law, MD; Talal D. Bazzi, BS; Meredith Van Harn, MS; John R. Craig, MD; Robert H. Deeb, MD

Objectives/Hypothesis: Determine the postoperative Nasal Obstruction Symptom Evaluation (NOSE) score stability between 1 and ≥6 months after septoplasty with inferior turbinate reduction (ITR). Education level and occupation were evaluated to determine their effects on NOSE score stability during the postoperative period.

Study Design: Retrospective case series.

Methods: This was a retrospective case series. Patients were included if they underwent septoplasty with ITR for nasal obstruction due to septal deviation and inferior turbinate hypertrophy. NOSE scores were collected preoperatively, and at 1 and ≥6 months postoperatively. Education level and occupation were collected postoperatively via telephone survey. Changes in NOSE scores were compared between the different time points. Education level and occupation were analyzed to determine if they affected NOSE scores.

Results: There were 98 patients included, and 56 were male (57.1%). Mean NOSE scores preoperatively and at 1 and ≥6 months postoperatively were 72.1, 17.1, and 12.0, respectively. Patients demonstrated a statistically and clinically significant reduction in NOSE score at 1 month (−54.9, $P < .001$) and at ≥6 months postoperatively (−60.0, $P < .001$). The mean 6.2-point decrease in NOSE score from 1 to ≥6 months was statistically, but not clinically significant. There were no significant differences in NOSE score changes based on educational level and occupation.

Conclusions: Patients achieved statistically and clinically significant reductions in NOSE scores at 1 months, with no clinically significant differences in NOSE scores at ≥6 months, suggesting NOSE score stability between these postoperative time points. Neither education level nor occupation influenced NOSE scores.

Key Words: NOSE, socioeconomic status, septoplasty outcomes, inferior turbinate reduction, NOSE score stability.

Level of Evidence: 4.

***Laryngoscope*, 00:1–6, 2020**

INTRODUCTION

Nasal septal deviation and inferior turbinate hypertrophy (ITH) are very common causes of nasal obstruction. When medical therapies fail, septoplasty with or without inferior turbinate reduction (ITR) are highly successful at resolving nasal obstruction.[1–6] The Nasal Obstruction Symptom Evaluation (NOSE) scoring system is a validated questionnaire to determine patients' subjective severity of nasal obstruction.[1–3,7–10] Preoperative NOSE scores can help otolaryngologists determine if septoplasty and ITR will be beneficial, while postoperative NOSE scores help quantify patients' symptomatic improvement after surgery.

Many studies have tried to determine factors that predict surgical success after septoplasty with or without ITR. It has been shown that patients with worse preoperative nasal obstruction and NOSE scores tend to experience more relief after surgery.[3] Other factors such as gender, smoking status, depression and anxiety, and type of deviation have been evaluated, but none have been shown to predict outcome.[2,5,11,12] While multiple studies have shown that low socioeconomic status (SES) can negatively impact postoperative outcomes after various types of surgery,[13–17] there is very limited data in the literature regarding the effects of SES on postoperative NOSE score changes after septoplasty with ITR. The effects of SES on postoperative outcomes are likely multifactorial and could be due to disparities in factors such as income and insurance status. Additionally, patient factors such as education level or occupation could potentially affect patient-reported outcomes like the NOSE score.

The purpose of this study was to determine if mean NOSE scores at 1 month postoperatively were similar to NOSE scores at ≥6 months postoperatively. This would determine whether subjective improvement in nasal patency after septoplasty and ITR at 1 month postoperatively would predict sustained long-term improvements at ≥6 months postoperatively. A secondary aim was to determine if educational level and occupation, as surrogates of SES, influenced postoperative NOSE scores and their stability over time.

From the Department of Otolaryngology-Head and Neck Surgery (R.H.L., J.R.C., R.H.D.), Henry Ford Hospital, Detroit, Michigan, U.S.A.; Department of Otolaryngology-Head and Neck Surgery (T.D.B.), Wayne State University School of Medicine, Detroit, Michigan, U.S.A.; and the Department of Public Health Sciences (M.V.H.), Henry Ford Health System, Detroit, Michigan, U.S.A.

Editor's Note: This Manuscript was accepted for publication on October 21, 2020.

The authors have no funding, financial relationships, or conflicts of interest to disclose.

Send correspondence to Robert H. Deeb, MD, 2799 W. Grand Blvd, ENT K8, Detroit, MI 48072. E-mail: rdeeb1@hfhs.org

DOI: 10.1002/lary.29229

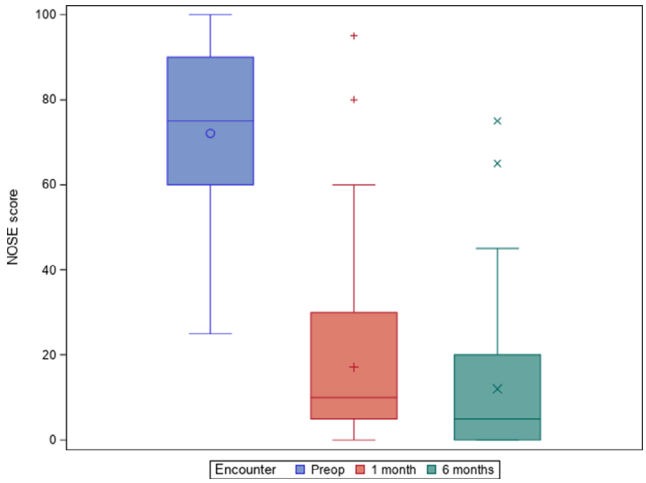

Fig. 1. Box and whisker plots of NOSE scores at various time points. Box plots are read as follows: The top whisker shows the max observation below the upper fence (which is 1.5× the IQR, with the IQR being the difference between the 75th and 25th percentile), the top of the box is the 75th percentile, the circle in the middle is the mean, the line in the middle is the median, the bottom of the box is the 25th percentile, the bottom whisker is the minimum observation, and the dots are outliers. 1 mo = 1 month postoperative; 6 mo = 6 months postoperative; IQR = interquartile range; NOSE = nasal obstruction symptom evaluation; Preop = preoperative. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

MATERIALS AND METHODS

A retrospective case series study was conducted for patients who underwent septoplasty with ITR from January 2017 through January 2020. Institutional review board approval was received. Inclusion criteria included adults ≥18 years old who underwent septoplasty with ITR for symptomatic nasal obstruction due to septal deviation and ITH not responsive to ≥1 month trial of topical intranasal corticosteroids, or additional intranasal or oral anti-histamines in patients with allergic rhinitis. Demographic data and NOSE scores were obtained preoperatively. Deviated septum and ITH were diagnosed based on history and nasal endoscopic exam. All patients were evaluated for external and internal nasal valve stenosis or collapse, as well as for sinusitis based on clinical history and nasal endoscopy. Exclusion criteria included patients <18 years old, concurrent nasal valve collapse and surgery, concurrent sinusitis or sinus surgery, history of previous septoplasty, sinonasal neoplasia, and history suggesting autoimmune conditions affecting the sinonasal cavities.

NOSE scores at 1 and ≥6 months postoperatively were documented. Changes in NOSE scores were compared between the different time points. Education level and occupation were collected postoperatively and analyzed to determine their effects on postoperative NOSE scores. Occupation was stratified into unemployed, entry-level, mid-tier, and advanced-level. Stratification correlated with education level. Entry-level jobs consisted of patients with high school or some college education and included manual labor, trade work, sales and service, house-keeping, store greeter, mechanic, and construction worker. Mid-tier consisted of

TABLE I.
Descriptive Statistics for All Variables.

Variable	Response	Mean (SD) or N (%)	Median (Min, Max)	*P*-Value
Total, N	98			
Age, years		42.5 (16.6)	39 (18, 84)	
Sex	Male	56 (57.1%)		
	Female	42 (42.9%)		
Splints	None	15 (15.3%)		
	Splint	83 (84.7%)		
Preoperative NOSE score		72.1 (19.0)	75 (25, 100)	
1-mo NOSE score		17.1 (18.6)	10 (0, 95)	
≥6-mo NOSE score (n = 89)		12.0 (14.6)	5 (0, 75)	
Change in NOSE from preoperative to 1 mo		−54.9 (23.2)	−55 (−100, 0)	<.001
Change in NOSE from preoperative to ≥6 mo (n = 89)		−60.0 (20.8)	−60 (−100, −15)	<.001
Change in NOSE from 1 mo to ≥6 mo (n = 89)		−6.2 (17.2)	−5 (−75, 40)	<.001
Occupation (n = 85)	Unemployed	13 (15.3%)		
	Entry level	36 (42.4%)		
	Mid-tier	25 (29.4%)		
	Advanced	11 (12.9%)		
Education level (n = 85)	High school/some college	28 (32.9%)		
	College	35 (41.2%)		
	Post-graduate	22 (25.9%)		
Change from preoperative to 1 mo ≥−26 points	No	43 (43.9%)		
	Yes	55 (56.1%)		
Change from preoperative to ≥6 mo ≥−26 points (n = 82)	No	30 (33.7%)		
	Yes	59 (66.3%)		

N = 98 unless otherwise noted.

Signed-rank tests were used to determine whether the change in NOSE score from preoperative to 1 and ≥6 months postoperative were statistically significant. With *P*-values all <.05, NOSE score at each time point is significantly different.

Max = maximum; Min = minimum; NOSE = Nasal Obstruction Symptom Evaluation; SD = standard deviation.

patients with a college degree and included teacher, management, law enforcement, marketing, professional artists and musicians, finance, accounting, business, nursing, and current students pursuing a bachelor's degree. Advanced occupations consisted of patients with post-graduate or doctoral level degrees and included scientists, engineers, advanced healthcare providers (medical doctors, nurse practitioners and physician assistants), and lawyers.

Technique

Septoplasties were performed through a hemitransfixion incision, and submucosal dissection was performed followed by removal of the deviated portions of septal bone and cartilage. Surgeons were careful to maintain at least 1-centimeter dorsal and caudal struts. Surgeons performed septoplasties endonasally, endoscopically or a combination thereof, based on surgeon preference. Bilateral submucosal reductions of the inferior turbinates were performed with a microdebrider blade. Patients had Doyle nasal splints placed at conclusion of the surgeries which were removed 5–7 days postoperatively.

Statistical Analysis

Continuous variables were described using means, standard deviations, medians, minimums, and maximums. Categorical variables were described using counts and percentages. Signed-rank tests were used to determine whether the NOSE score changes from preoperatively to 1 and 6 months postoperatively were statistically significant. Kruskal-Wallis tests were used to compare NOSE scores between education level and occupation groups. Nonparametric tests were used because the distribution of NOSE scores were found to be non-Gaussian via histograms, Q-Q plots, and Shapiro–Wilk tests. Univariate and multivariable mixed-effects models were employed and, based on

TABLE II.
NOSE Score by Profession.

Variable	Mean (SD)	Median (Min, Max)
Unemployed (N = 13)		
Preoperative NOSE score	77.3 (19.5)	80 (35, 100)
1-mo NOSE score	24.6 (25.7)	15 (0, 95)
≥6-mo NOSE score	18.5 (19.3)	20 (0, 75)
Change in NOSE from preoperative to 1 mo	−52.7 (27.1)	−55 (−100, 0)
Change in NOSE from preoperative to ≥6 mo	−58.8 (21.4)	−70 (−80, −15)
Change in NOSE from 1 to ≥6 mo	−6.2 (14.6)	−5 (−30, 25)
Entry level (N = 36)		
Preoperative NOSE score	72.9 (21.7)	75 (25, 100)
1-mo NOSE score	15.4 (14.9)	10 (0, 50)
≥6-mo NOSE score (n = 32)	10 (14.3)	5 (0, 65)
Change in NOSE from preoperative to 1 mo	−57.5 (24.2)	−57.5 (−100, −15)
Change in NOSE from preoperative to ≥6 mo (n = 32)	−63.9 (21.1)	−60 (−100, −20)
Change in NOSE from 1 to ≥6 mo	−5.9 (15.2)	0 (−40, 35)
Mid-tier (N = 25)		
Preoperative NOSE score	67.2 (15.3)	65 (40, 95)
1-mo NOSE score	17.2 (19.5)	10 (0, 80)
≥6-mo NOSE score	8.6 (10.9)	5 (0, 40)
Change in NOSE from preoperative to 1 mo	−50 (19.1)	5 (0, 40)
Change in NOSE from preoperative to ≥6 mo	−58.6 (20.8)	−60 (−95, −20)
Change in NOSE from 1 to ≥6 mo	−8.6 (20.5)	−5 (−75, 20)
Advanced (N = 11)		
Preoperative NOSE score	71.8 (14.7)	75 (45, 100)
1-mo NOSE score	15.5 (20.2)	5 (0, 60)
≥6-mo NOSE score (n = 9)	12.2 (10)	15 (0, 25)
Change in NOSE from preoperative to 1 mo	−56.4 (20.3)	−60 (−80, −15)
Change in NOSE from preoperative to ≥6 mo (n = 9)	−58.3 (18)	−55 (−85, −30)
Change in NOSE from 1 to ≥6 mo	−5.6 (20.4)	−5 (−45, 20)

Descriptive statistics of NOSE scores (preoperative, 1 month, ≥6 months, change from preoperative to 1 month, and change from preoperative to ≥6 months) broken down by profession. Each variable was compared between professions, but none were significant (data not shown).

Max = maximum; Min = minimum; NOSE = Nasal Obstruction Symptom Evaluation; SD = standard deviation.

TABLE III.
NOSE Score by Education Level.

Variable	Mean (SD)	Median (Min, Max)
High school/some college (N = 28)		
Preoperative NOSE score	72.9 (19.8)	75 (25, 100)
1-mo NOSE score	21.1 (21.0)	17.5 (0, 80)
≥6-mo NOSE score (n = 26)	12.1 (11.7)	5 (0, 40)
Change in NOSE from preoperative to 1 mo	−51.8 (25.1)	−55 (−100, −5)
Change in NOSE from preoperative to ≥6 mo (n = 26)	−60.2 (22.5)	−60 (−95, −20)
Change in NOSE from 1 to ≥6 mo	−10 (20.7)	−5 (−75, 20)
College (N = 35)		
Preoperative NOSE score	74.1 (16.6)	75 (45, 100)
1-mo NOSE score	15.9 (14.8)	10 (0, 60)
≥6-mo NOSE score (n = 32)	9.8 (13.9)	5 (0, 65)
Change in NOSE from preoperative to 1 mo	−58.3 (18.9)	−60, (−100, −25)
Change in NOSE from preoperative to ≥6 mo (n = 32)	−65.8 (14)	−70 (−100, −35)
Change in NOSE from 1 to ≥6 mo	−6.4 (15.9)	−5 (−45, 35)
Post-graduate (N = 22)		
Preoperative NOSE score	66.6 (20.7)	67.5 (30, 100)
1-mo NOSE score	15.0 (21.7)	10 (0, 95)
≥6-mo NOSE score (n = 21)	12.1 (17.1)	5 (0, 75)
Change in NOSE from preoperative to 1 mo	−51.6 (24.9)	−50 (−100, 0)
Change in NOSE from preoperative to ≥6 mo (n = 21)	−53.8 (24.8)	−55 (−100, −15)
Change in NOSE from 1 to ≥6 mo	−3.3 (14.3)	0 (−30, 20)

Descriptive statistics of each NOSE score (preoperative, 1 month, ≥6 months, change from preoperative to 1 month, and change from preoperative to ≥6 months) broken down by education level. Each variable was compared between education groups, but none were significant (data not shown).

Max = maximum; Min = minimum; NOSE = Nasal Obstruction Symptom Evaluation; SD = standard deviation.

TABLE IV.
Univariate Mixed-Effects Model for Repeated Measurements: NOSE Scores Compared Across Time.

Time	LSM (SE)	*P*-Value
Preoperative NOSE score	72.1 (1.9)	**<.01**
1-mo NOSE score	17.1 (1.9)	
≥6-mo NOSE score	11.6 (1.5)	

Time	Differences in LSM (SE)	95% CI of Difference
Change in NOSE from preoperative to 1 mo	54.9 (2.3)	50.3, 59.6
Change in NOSE from preoperative to ≥6 mo	60.5 (2.3)	55.9, 65.0
Change in NOSE from 1 to ≥6 mo	5.5 (1.8)	2.1, 9.0

Significant *P*-values are bolded.

Univariate (Table IV) and multivariable (Table V) mixed-effects models were employed and, based on optimized Akaike Information Criterion and Bayesian Information Criterion, an antedependence covariance structure was chosen to allow for unequally spaced measurements over time.

CI = confidence interval; LSM = least squared mean; NOSE = Nasal Obstruction Symptom Evaluation; SE = standard error.

optimized Akaike Information Criterion and Bayesian Information Criterion, an antedependence covariance structure was chosen to allow for unequally spaced measurements over time. Statistical significance was set at $P < .05$. All analyses were performed using SAS 9.4 (SAS Institute Inc, Cary, NC). The minimal important difference used was a reduction in NOSE score of ≥26 point based on Ziai and Bonaparte's study.[18] The study was conducted with a sample size larger than previous studies.

RESULTS

Ninety-eight patients were included in the study. Mean age was 42.5 years and 57.1% were male. The means ± standard deviations of NOSE scores preoperatively and at 1 and ≥6 months postoperatively were 72.1 ± 19, 17.1 ± 18.6, and 12 ± 14.6, respectively. The NOSE score medians and interquartile ranges (IQR) of the different time points are depicted in Figure 1. The mean change in NOSE score from preoperatively to 1 month postoperatively was −54.9 ± 23.2 ($P < .001$), from preoperatively to ≥6 months postoperatively was −60 ± 20.8 ($P < .001$), and from 1 to ≥6 month postoperatively was −6.2 ± 17.2 ($P < .001$) (Table I). The percentage of patients achieving a minimally important reduction in mean NOSE scores between preoperative and 1 month postoperatively was 56.1% and between preoperative and ≥6 months postoperatively was 66.3% (Table I).

Occupation and education level were obtained from 85 patients. Of the 85 patients, 13 (15.3%) were unemployed, 36 (42.4%) had entry-level jobs, 25 (29.4%) had mid-tier jobs, and 11 (12.9%) had advanced-level jobs (Table I). Of the 85 patients, 28 (32.9%) graduated high school or had some college experience, 35 (41.2%) graduated college, and 22 (25.9%) had post-graduate degrees (Table I).

Subgroup analysis was performed to evaluate the mean NOSE score changes between the different occupation categories and between the education levels as well. The mean changes in NOSE scores between the different time points were not statistically different between the different occupation or education levels (Tables II and III).

Similar findings were seen with univariate and multivariable mixed-effects models (Tables IV and V). When controlling for all SES variables, NOSE score was significantly different across all time points ($P < .001$), but none of the SES variables were independent predictors of NOSE score (Table V).

DISCUSSION

Septoplasty and ITR is successful in treating nasal obstruction due to nasal septal deviation and ITH. While

TABLE V.
Multivariable Model.

Independent Variable	Response	Adjusted LSM (SE) of NOSE or Est (SE)	*P*-Value
Time	Preoperative NOSE score	72.6 (2.2)	**<.001**
	1-mo NOSE score	18.2 (2.2)	
	≥6-mo NOSE score	11.8 (1.7)	
Age	Est (SE)	0.07 (0.1)	.422
Sex	Female	33.6 (2.2)	.654
	Male	34.8 (1.9)	
Occupation	Advanced	34.4 (3.8)	.325
	Entry Level	32.7 (2.1)	
	Mid-tier	30.6 (2.5)	
	Unemployed	39.0 (3.8)	
Education	College	33.2 (2.1)	.624
	High school/some college	36.0 (2.5)	
	Post graduate	33.3 (2.7)	

Significant *P*-values are bolded.

Results of a multivariable model with the least-squared means of NOSE score for time, age, sex, occupation, and education. The beta estimate and standard error for change in NOSE for every 1-year increase in age is given.

Est = beta estimate; LSM = least squared mean; NOSE = Nasal Obstruction Symptom Evaluation; SE = standard error.

a variety of objective and subjective measures have been used to demonstrate success after nasal obstruction surgery, measuring subjective nasal obstruction with the NOSE score is a reliable method to measure effectiveness.[3,7–10] Stewart et al were one of the first to establish the NOSE scoring system as a validated questionnaire to determine patient-reported severity of nasal obstruction.[3] Subsequent studies have established normative values and minimal important differences.[18,19] The NOSE questionnaire has become a quick and reliable clinical tool to assess for improvement in nasal obstruction symptoms postsurgically as well.

Despite many studies demonstrating the validity and reliability of the NOSE questionnaire, there are very few studies evaluating predictors of the long-term stability of NOSE scores following septoplasty with ITR. There are very few studies evaluating SES and its effect on NOSE scores, and no studies have specifically assessed the effects of occupation and education level on outcomes of septoplasty and ITR. The first aim of this study was to determine whether NOSE scores improved and stabilized by 1 month postoperatively. The second aim was to determine whether patient occupation and education level affected long-term NOSE score stability.

Three prior studies have assessed NOSE score stability after septoplasty.[2,5,12] Stewart et al (n = 59) and Gillman et al (n = 67) demonstrated no significant changes in NOSE scores between 3 month and 6 months after septoplasty.[2,5] Gandomi et al also found no difference in NOSE scores between 3 months and 6 months after septoplasty; however, they used a 9-question survey instead.[4] The modified questionnaire did include the 5 validated questions in the original NOSE score questionnaire, but they did not add the total scores. Instead, they rated the severity of each symptom on the scale of 0–4. As a result, they could not determine improvement based on the validated minimal important difference of 26.[18] Furthermore, they included a small sample of only young patients, limiting generalizability of their findings.

Hong et al (n = 49) also did not show any statistical differences in NOSE scores between 3 months and 6 months postoperatively. Their study did show a statistical difference in the raw NOSE scores between 1 month and 3 months postoperatively, but was not clinically significant. More importantly, this study is one of the few that evaluated how psychological factors, allergies, and severity of septal deviation affected long-term NOSE score stability. They used Beck's Depression Index and a simple stress questionnaire to measure the severity of depression and anxiety. They did not find any significant correlation between the above factors and NOSE score changes at 3 months postoperatively on univariate and multivariate analysis except for anxiety. They showed that patients with higher stress questionnaire scores showed greater improvement in NOSE scores postoperatively. Overall, none of the above studies analyzed potential effects of occupation and education levels on long-term stability of NOSE scores. Only Hong et al's study looked at postoperative NOSE scores at 1 month while the rest looked at postoperative NOSE scores 3 months and later.

This current study is the largest study to date assessing long-term NOSE score stability after septoplasty and ITR and is the first study to assess whether occupation and education levels affect long-term NOSE score stability. All patients experienced statistically and clinically significant reductions in the mean NOSE scores at 1 and ≥6 months postoperatively. Although there was a statistically significant reduction in NOSE scores between 1 and ≥6 months postoperatively among all patients, the 6-point decrease was not clinically significant.[18] The significant improvements patients experienced by 1 month after surgery is encouraging and could predict long-term nasal patency ≥6 months. As there is little to no data in the literature favoring follow-up of patients undergoing septoplasty and ITR beyond 1 month postoperatively, the decision is largely based on surgeon preference. The findings from this study suggest that these patients may not require routine follow-up beyond 1 month postoperatively.

It has been well-established that SES can have a significant effect on surgical outcomes,[13–17] the reason for which is likely multifactorial. This current study only assessed patients' occupation and education levels, but these variables did not affect mean postoperative NOSE scores or long-term NOSE score stability. This finding may be due to the fact that nasal obstruction is not a life-threatening disease and delayed presentation does not result in poor surgical outcomes. This is in contrast to head and neck cancers, where SES can dramatically influence outcomes. Patients who are of low SES have limited health care access and often present with more advanced stage cancers; based on the current literature, those who present with more advanced head and neck cancer tend to have worse outcome in regard to local regional recurrence and 5-year survival.[20–24] These health care disparity findings hold true for certain time-sensitive disease processes, but may not be applicable or translatable to the same degree for non-life threatening disease processes such as nasal obstruction due to septal deviation and ITH.

The data on education level on surgical outcomes is mixed and vary from procedure to procedure. For example, one study evaluating the outcomes of patients who underwent surgical treatment for long bone fractures showed that patients of lower SES had significantly higher rates of non-union.[25] Another study showed that bariatric patients with low health literacy have a significantly lower expected weight loss and higher return visits; however, no difference was seen across education level.[26] Perhaps in this case, lower health literacy is not also correlative with education level. There are currently no other studies that have elevated occupation and education level and their effects on NOSE score stability. As mentioned, this study showed that occupation and education level did not significantly impact NOSE scores or long-term NOSE score stability.

Limitations also deserve mention. A main limitation of this study was the retrospective design. Additionally, surgery was performed by 2 different surgeons, and thus subtle differences in technique are likely. Another factor is that it is difficult to determine which disease process outcomes are more influenced by SES. Also other SES factors, such as income and insurance status, were not evaluated in this study.

CONCLUSION

Patients achieved statistically and clinically significant reductions in NOSE scores at 1 month, with no clinically significant differences in NOSE scores at ≥6 months, suggesting NOSE score stabilized by 1 month postoperatively. Neither education level nor occupation influenced postoperative NOSE score changes or NOSE score stability.

BIBLIOGRAPHY

1. Mondina M, Marro M, Maurice S, Stoll D, de Gabory L. Assessment of nasal septoplasty using NOSE and RhinoQoL questionnaires. *Eur Arch Otorhinolaryngol* 2012;269:2189–2195.
2. Stewart MG, Smith TL, Weaver EM, et al. Outcomes after nasal septoplasty: results from the Nasal Obstruction Septoplasty Effectiveness (NOSE) study. *Otolaryngol Head Neck Surg* 2004;130:283–290.
3. Stewart MG, Witsell DL, Smith TL, Weaver EM, Yueh B, Hannley MT. Development and validation of the Nasal Obstruction Symptom Evaluation (NOSE) scale. *Otolaryngol Head Neck Surg* 2004;130:157–163.
4. Gandomi B, Bayat A, Kazemei T. Outcomes of septoplasty in young adults: the Nasal Obstruction Septoplasty Effectiveness study. *Am J Otolaryngol* 2010;31:189–192.
5. Gillman GS, Staltari GV, Chang Y-F, Mattos JL. A prospective study of outcomes of septoplasty with turbinate reductions in patients with allergic rhinitis. *Otolaryngol Head Neck Surg* 2019;160:1118–1123.
6. Han JK, Stringer SP, Rosenfeld RM, et al. Clinical consensus statement: septoplasty with or without inferior turbinate reduction. *Otolaryngol Head Neck Surg* 2015;153:708–720.
7. Spiekermann C, Savvas E, Rudack C, Stenner M. Adaption and validation of the nasal obstruction symptom evaluation scale in German language (D-NOSE). *Health Qual Life Outcomes* 2018;16:172.
8. Lachanas VA, Tsiouvaka S, Tsea M, Hajiioannou JK, Skoulakis CE. Validation of the nasal obstruction symptom evaluation (NOSE) scale for Greek patients. *Otolaryngol Head Neck Surg* 2014;151:819–823.
9. Dąbrowska-Bień J, Skarżyński H, Gos E, Gwizdalska I, Lazecka KB, Skarżyński PH. Clinical evaluation of a Polish translation and cross-cultural adaptation of the nasal obstruction symptom evaluation (NOSE) Scale. *Med Sci Monit* 2018;24:7958–7964.
10. van Zijl FVWJ, Timman R, Datema FR. Adaptation and validation of the Dutch version of the nasal obstruction symptom evaluation (NOSE) scale. *Eur Arch Otorhinolaryngol* 2017;274:2469–2476.
11. Valsamidis K, Titelis K, Karkos P, Markou K, Constantinidis J, Triaridis S. Predictive factors of patients' general quality of life after nasal septoplasty. *Eur Arch Otorhinolaryngol* 2019;276:429–438.
12. Hong SD, Lee N-J, Cho H-J, et al. Predictive factors of subjective outcomes after septoplasty with and without turbinoplasty: can individual perceptual differences of the air passage be a main factor? *Int Forum Allergy Rhinol* 2015;5:616–621.
13. Bergmark RW, Hoehle LP, Chyou D, et al. Association of socioeconomic status, race and insurance status with chronic rhinosinusitis patient-reported outcome measures. *Otolaryngol Head Neck Surg* 2018;158:571–579.
14. Bergmark RW, Sedaghat AR. Disparities in health in the United States: an overview of the social determinants of health for otolaryngologists. *Laryngoscope Investig Otolaryngol* 2017;2:187–193.
15. Hauch A, Al-Qurayshi Z, Friedlander P, Kandil E. Association of socioeconomic status, race, and ethnicity with outcomes of patients undergoing thyroid surgery. *JAMA Otolaryngol Head Neck Surg* 2014;140:1173–1183.
16. Shen SA, Jafari A, Qualliotine JR, DeConde AS. Socioeconomic and demographic determinants of postoperative outcome after endoscopic sinus surgery. *Laryngoscope* 2020;130:297–302.
17. Qasim M, Andrews RM. Despite overall improvement in surgical outcomes since 2000, income-related disparities persist. *Health Aff (Millwood)* 2013;32:1773–1780.
18. Ziai H, Bonaparte JP. Determining a successful nasal airway surgery: calculation of the patient-centered minimum important difference. *Otolaryngol Head Neck Surg* 2017;157:325–330.
19. Rhee JS, Sullivan CD, Frank DO, Kimbell JS, Garcia GJM. A systematic review of patient reported nasal obstruction scores: defining normative and symptomatic ranges in surgical patients. *JAMA Facial Plast Surg* 2014;16:219–232.
20. Medow MA, Weed HG, Schuller DE. Simple predictors of survival in head and neck squamous cell carcinoma. *Arch Otolaryngol Head Neck Surg* 2002;128:1282–1286.
21. Cadoni G, Giraldi L, Petrelli L, et al. Prognostic factors in head and neck cancer: a 10-year retrospective analysis in a single-institution in Italy. *Acta Otorhinolaryngol Ital* 2017;37:458–466.
22. Chen AY, Schrag NM, Halpern M, Stewart A, Ward EM. Health insurance and stage at diagnosis of laryngeal cancer: does insurance type predict stage at diagnosis? *Arch Otolaryngol Head Neck Surg* 2007;133:784–790.
23. Cheraghlou S, Kuo P, Mehra S, Yarbrough WG, Judson BL. Untreated oral cavity cancer: long-term survival and factors associated with treatment refusal. *Laryngoscope* 2018;128:664–669.
24. Ellis L, Canchola AJ, Spiegel D, Ladabaum U, Haile R, Gomez SL. Trends in cancer survival by health insurance status in California from 1997 to 2014. *JAMA Oncol* 2018;4:317–323.
25. Kugelman DN, Haglin JM, Carlock KD, Konda SR, Egol KA. The association between patient education level and economic status on outcomes following surgical management of (fracture) non-union. *Injury* 2019;50:344–350.
26. Mahoney ST, Strassle PD, Farrell TM, Duke MC. Does lower level of education and health literacy affect successful outcomes in bariatric surgery? *J Laparoendosc Adv Surg Tech A* 2019;29:1011–1015.