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Predictors of six month change in the voice handicap index in a treatment seeking population

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Abstract

Objective—To evaluate predictors of longitudinal change in patient-perceived voice impact as determined by the Voice Handicap Index (VHI).

Study Design—Prospective, survey study.

Methods—Patients consented to the UW Voice and Swallow Clinics Outcomes Database with voice, breathing and/or cough concerns with a baseline clinic visit from November 2012 to January 2014 were eligible for the study. VHI was sent to patients six months post-clinic visit to determine change in voice handicap from baseline. General health was screened using the SF-12v2 survey, using physical component (PCS) and mental component summary (MCS) scores. Predictor variables included – treatment (medical and/or behavioral), dysphonia sub-diagnosis, GRBAS rating, age, sex, socioeconomic factors, smoking history, and comorbidity score.

Results—Two-hundred thirty-seven patients met study criteria and were followed longitudinally. Eighty-two patients returned six month surveys. VHI was significantly correlated with MCS scores. Patients with a higher grade in baseline GRBAS score were more likely to receive voice intervention ($p = .04$). Six-month improvement in VHI score was associated with both higher initial VHI score and higher education level in both univariate ($p < .01$, $p = .04$) and multivariate analyses ($p < .01$, $p = .02$). Voice treatment (medical and/or behavioral) was not a significant factor for improvement in VHI.

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Conclusions—Our results suggest it is important to consider baseline self-perceived voice impact measures and education level in setting expectations for voice treatment. Future studies examining the relationship between treatment patterns and voice-related patient outcomes are warranted.

Keywords

Voice; voice disorders; Voice Handicap Index; patient-centered outcomes; long term outcomes

INTRODUCTION

Disorders of the voice and diseases of the larynx are a growing public health concern. While typically benign and not considered to be life-threatening, they often affect communication abilities in both social and occupational contexts and can adversely affect quality of life. Recent reports show these disorders have direct health care costs in the U.S. approaching \$4.9 billion annually, including evaluation and treatment costs.¹ An estimated 7% of the workforce miss a day or more of work each year with nearly 50% of treatment-seeking patients reporting voice problems affecting their current work abilities.^{2,3} Dysphonia, or disordered voice, has a reported lifetime prevalence of nearly 30%,³ indicating a significant public health impact.

In the current health care climate, there is a growing emphasis on patient-centered care and outcomes.^{4,5} The patient's own subjective concerns plays an important role in the complex clinical evaluation as well as guiding the basis for a treatment plan. The Voice Handicap Index (VHI) is a validated assessment tool that captures the severity of the voice problem from the patient's perspective, including functional, physical and emotional domains.⁶ It is widely used in clinical evaluations of dysphonia, which also includes clinician rated measures of perception such as the overall dysphonia grade, roughness, breathiness, asthenia, and strain (GRBAS) or Consensus Auditory Perceptual Evaluation of Voice (CAPE-V) scales, patient medical history, videostroboscopy ratings and objective acoustic and aerodynamic measures. However, the VHI is weakly correlated to other clinical voice evaluation measures, such as jitter %, shimmer %, signal-to-noise ratio, maximum phonation time, dysphonia severity index, subglottic pressure, mean flow⁷⁻¹⁰ and patients have demonstrated wide variability in their VHI scores presenting with similar vocal pathology and objective measures.¹¹

The VHI and other patient-reported voice scales like the Voice-Related Quality of Life questionnaire (V-RQOL)¹²⁻²⁰, Voice Symptom Scale (VoiSS)^{14,21,22} and Vocal Performance Questionnaire (VPQ)²³⁻²⁶ are commonly used in dysphonia outcomes research. However, factors driving patient-perceived improvement in voice handicap are not well understood. Studies have examined the same clinical evaluation measures listed above to predict patient perception using the VHI, but these were completed once and were not prospectively followed.^{8,27} Other studies have focused on treatment efficacy longitudinally, but looked at one specific diagnosis such as laryngeal cancer, vocal fold paralysis or spasmodic dysphonia.²⁸⁻³² One patient-centered outcomes study used voice-related quality of life measures (VHI, VPQ and VoiSS) to examine responsiveness to change after voice therapy or

phonosurgery. This study demonstrated large effect sizes in overall improvement in voice-specific questionnaires post-treatment, however it did not consider patients diagnosed with a voice or other laryngeal disorder not seeking follow-up treatment.³³ Additionally, longitudinal analyses of individuals with functional voice disorders demonstrated a high rate of recurrences of dysphonia in 51% to 68% of patients following treatment, suggesting a lack of long term improvements in these individuals.^{34,35} The primary goal of this study was to assess how patient-reported outcomes change as the result of additional treatment after evaluation (medical and/or behavioral). Additionally, we were interested in other patient characteristics that have not been explored previously to determine if these predict change in self-perceived voice handicap. To our knowledge, this is the first study to evaluate specific patient characteristics predictive of long-term change in patient-centered dysphonia measures. Understanding factors that drive change in patient-centered outcome measures, like the VHI, will help guide clinical care and optimize expectations when treating patients with voice disorders.

METHODS

Study Population

Patients consented to the UW Voice and Swallow Clinics Outcomes Database from November 2012 through January 2014 were eligible for this study. Establishment and subsequent use of this database has been approved by the University of Wisconsin Madison School of Medicine and Public Health Institutional Review Board. Information in the database is obtained with patient consent for those who visit the Otolaryngology Head and Neck Clinic for a complaint related to voice or swallow and includes patient health information for over 4000 persons.

All patients in the UW Voice and Swallow Clinics Outcomes Database were initially evaluated by a speech-language pathologist (SLP) and otolaryngologist (ENT) due to concerns with voice, cough and/or breathing. Only those patients with concerns regarding voice or vocal quality were included in this study. Baseline data were collected during the visit and from an intake form filled out by the patient including the primary outcome variable, the Voice Handicap Index (VHI). Patient's also completed a general health questionnaire, a 12-item Short Form Health Survey, the SF-12v2. Additional patient-level variables collected included an auditory-perceptual rating of dysphonia (GRBAS), dysphonia diagnosis (benign laryngeal disorders, chronic laryngitis, neurologic disorders), age, sex, smoking history, presence of comorbidities, treatment (medical and/or behavioral), and socioeconomic factors - educational attainment and mean income, collected from census level data obtained from patient zip code. SF-12v2 and VHI surveys were sent to consented patients six months after his/her last visit to the clinic. For patients who received an evaluation only, surveys were sent six months after that encounter date. For patients who received additional treatment, surgical and/or behavioral, surveys were sent six months after the last voice intervention or follow-up evaluation encounter date.

Voice Handicap Index (Primary Outcome Variable)

The VHI⁶, a self-administered, validated questionnaire consists of 30 questions based on three different domains that measure functional, physical and emotional aspects of the voice. Total scores range from 0 (no voice handicap) to 120 (maximum voice handicap), which were used in the current study. It measures the impact of voice problems in everyday life and has demonstrated sensitivity to change following therapy, medical and surgical voice management.³³

SF-12v2

The SF-12v2[®] Health Survey³⁶, a self-administered, validated questionnaire is a global measure of health. It uses 12 questions to measure functional health and well-being. The SF-12 series cover all eight health domains from the SF-36 using a subset of the same questions, therefore results can be compared and the survey can be completed in two minutes or less.³⁷ The SF-12v2 contains changes to the original SF-12 which includes improvements in layout, instructions and word simplification; modeling previous improvements made to the SF-36v2 from the original survey.³⁸ The SF-12v2 was collected to determine whether there was a correlation between changes in physical and/or mental health measures and changes within the VHI. Scores are reported as a physical component summary (PCS) score and a mental component summary (MCS) score derived from the survey questions. This survey was normalized on a subset of people within the U.S. and the average score is 50 for each scale, with a range from 0 (worst) to 100 (best).

Patient-level Variables

Patient-level variables retrieved from the UW Voice and Swallow Clinics Outcomes Database, included age, sex, smoking history, comorbidities and level of treatment. Age, sex and smoking history (yes, current or past, or no) are collected via a patient intake form. The Charlson Comorbidity Index quantified patient comorbidity using a program based on the original Charlson Comorbidity Index calculator. The index was originally created based on 1-year mortality data from 19 medical conditions with a weight of 1 (e.g., myocardial infarct) to 6 (malignant tumor), with scores ranging from 0 to 37. Patient age is also factored into the overall score.^{39,40} Socioeconomic factors were collected via the US Census Bureau's American Community Survey (ACS), based on patient five-digit zip codes; these data were obtained from the ACS 2007–2011 5-year estimates.⁴¹ Five-year estimates were chosen based on availability of data for patients living in small communities or rural areas and higher reliability of data compared to ACS 1- and 3-year estimates.⁴²

Other patient variables were determined at the initial voice evaluation by the SLP and ENT, including diagnosis, auditory-perceptual rating (GRBAS) and baseline VHI severity. Clinician-perceived perceptual rating was completed using the GRBAS scale. Overall grade (G) was chosen for this analysis, with scores ranging from 0 (normal) to 3 (severe). VHI severity was divided into four groups: no to minimal impairment (0–17), mild impairment (18–39), moderate impairment (40–59) and severe impairment (60+), based on cutoff values within the database.

Patient treatment following evaluation was broken down into two groups: medical and/or behavioral treatment and medication recommended, including nasal steroid, antibiotics and reflux prescriptions. Surgical treatment included operating room or office-based procedures performed by the ENT. Behavioral therapy included voice, cough suppression or respiratory retraining therapies performed by the SLP. Patient medication was recommended by the ENT during at least one visit during the study period. All eligible subjects were de-identified and the study variables were extracted from the clinical outcomes database for analysis. Patient exclusion criteria included: age less than 18 years, dysphagia as primary diagnosis or a diagnosis of head and neck cancer. Patients without a completed VHI score at the baseline visit were also excluded, including patients with a primary diagnosis of cough or paradoxical vocal fold motion disorder with no associated voice concerns.

Statistical Analysis

Descriptive statistics were included for VHI and SF-12v2 (baseline and six months), including means and standard deviations. A correlation coefficient was used to examine the relationship of general health and patient-perceived vocal quality of life. Differences between patient-level variables at baseline for patients who had additional behavioral and/or medical voice treatment after evaluation and those who did not have treatment were compared using individual t-tests and Fisher's exact tests for continuous and categorical variables, respectively. Percent change in VHI was calculated by subtracting the six month VHI score from the baseline score, divided by the baseline score for each subject to provide normalization. Univariate analyses determined which variables were predictive of change in VHI scores. Multivariate analyses were completed on all significant variables in the univariate analysis. Alpha levels below .05 were considered significant for all analyses.

RESULTS

Patient Characteristics

Four-hundred thirty four patients were consented and added to the UW Voice and Swallow Clinics Outcomes Database from November 2012 through January 2014. After meeting the study criteria, 237 patients were eligible for this study and were sent SF-12v2 and VHI questionnaires at six-months. Eighty-two patients (35% response rate) returned a six month follow-up survey during the study period and were included in the analysis. Mean VHI and SF-12v2 scores at baseline and six months are listed in Table 1. There was a statistically significant, weak correlation between VHI and MCS scores. As patients VHI scores improved over time (i.e., scores dropped), MCS scores of the SF-12v2 also increased ($r = -0.24$, $p = 0.03$). There was not a significant relationship with the PCS scores of the SF-12v2 ($r = -0.14$, $p = 0.22$).

Table 2 presents patient characteristics according to whether or not any treatment following initial evaluation (medical and/or behavioral) was received. In the treatment group, mean age was 61.4 years and 52.6% were female. Nearly 58% of this group had a smoking history, either current or in the past. Diagnoses were divided into three groups: chronic laryngitis, neurologic and benign laryngeal disorders. Each of these groups consisted of multiple distinct diagnoses listed in Table 3. Diagnoses were primarily benign laryngeal disorders

(55.3%), followed by chronic laryngitis (28.9%) and neurologic voice disorders (15.8%). Fifty percent of these patients had an overall grade on the GRBAS rating scale of 2 or higher, signifying a moderate to severe level of clinician-perceived dysphonia. Baseline VHI severity for this group was normal (44.7%), mild (31.6%), moderate (13.2%) and severe (10.5%). Overall comorbidity index score was 0.5, indicating low comorbidity relative to diseases such as cancer, dementia, heart, or kidney disease which result in higher scores. For census level data, bachelor's degree percentage was 35.1% and mean income was \$76,852.

In the non-treatment group, mean age was 56.3 years and 72.7% were female. Forty-five percent of this group had a smoking history. Diagnoses were primarily benign laryngeal disorders (47.7%), followed by chronic laryngitis (36.4%) and neurologic voice disorders (15.9%). Over 65% of these patients had an overall grade on the GRBAS rating scale of less than 2, signifying either a normal voice to mild level of dysphonia as perceived by the clinician. Compared to the treatment group, patients who did not receive treatment had significantly lower grade in baseline GRBAS ratings ($p = 0.03$). Baseline VHI severity for this group was normal (50%), mild (20.5%), moderate (15.9%) and severe (13.6%). Comorbidity index score was 1.1, also indicating low comorbidity in this group. For census level data, bachelor's degree percentage was 39.4% and mean income was \$77,693.

Percent Change in VHI

Mean baseline and six month follow-up scores for the VHI and mean percent change in VHI are shown in Table 4. Six participants with a baseline VHI score of zero were not included in this analysis as we were unable to calculate a percent change score ($n = 76$). In the univariate analysis, VHI severity ($p < 0.01$) and higher education level ($p = 0.04$) variables were both significant. In the multivariate analysis (Table 5), which included the significant variables from the univariate analysis, VHI severity ($p < .01$) and higher education level ($p = 0.02$) were both significant in the model ($p < 0.01$).

DISCUSSION

This study used a disease-specific clinical outcomes database to study a cohort of individuals seen for voice and other laryngeal concerns to determine long-term patient-centered outcomes. The primary goal was to examine factors predictive of change as measured by the voice handicap index (VHI). In this analysis, factors predictive of change in VHI were baseline VHI severity and higher education level. Our primary outcome variable, treatment, was not a significant predictor, regardless of whether patients had surgical treatment, behavioral voice therapy or medication recommended.

Our study cohort was predominantly female in both treatment and non-treatment groups, consistent with literature on female patients making up the majority of specialty voice care.¹ There was a significant difference in overall grade (G) of the GRBAS rating. Patients with an increasing grade on the rating scale were more likely to receive voice intervention. While no study has considered the relationship of GRBAS rating and likelihood of receiving treatment, there are studies showing a relationship between perceived voice severity and lower voice-related quality of life,^{43,44} which could be the driving factor for pursuing treatment. Reduced voice-related quality of life as it relates to treatment patterns may

warrant further study. No other significant differences in patient variables -- age, sex, smoking history, comorbidities, and other socioeconomic factors, income and percent bachelor's degree, were found. Three of these variables -- age, sex and education level have been studied previously with similar results. These variables were not found to be barriers for patients seeking dysphonia treatment.⁴⁵ It is important to note these other socioeconomic factors were based on averages of the patient's five-digit zip code obtained from the American Community Survey, not based on specific patient socioeconomic information. In addition, the UW Voice and Swallow Clinics Outcomes Database contains patient reported information, for example smoking history. Although not well documented in otolaryngology- head and neck surgery literature, previous studies have demonstrated low reliability in patient report regarding smoking habits in other patient populations.^{46,47}

Patients in the non-treatment group did not have additional medical and/or behavioral voice intervention at the UW Voice and Swallow Clinics during the study period. This data point is based on encounters at the clinic with associated dates. We do not have information on whether these patients received voice intervention elsewhere (e.g., a clinic closer to home) or if trial therapy was done during the evaluation, which is a limitation of this study.

There was a significant, yet weak correlation between MCS scores on the SF12v2 and VHI. Over time, as MCS scores improved, so did VHI scores. Whether improved mental health influenced improved voice quality of life, or vice versa, cannot be determined. Previous research has demonstrated lower health-related quality of life scores in patients with dysphonia.⁴⁹ As clinicians, paying specific attention to mental health history as well as overall general health may provide insight to future patient outcomes. This may be of particular importance for patients with functional dysphonias as this population has demonstrated increased depressive and anxiety symptoms.⁵⁰

Two factors predictive of change in the VHI scores were baseline VHI severity and higher education level. As VHI severity at baseline increased, patients demonstrated greater improvement in VHI scores at six months. The reason for this is unclear as little has been studied in the literature regarding this issue. Patients with moderate or severe VHI scores have more room for improvement than patients with normal or mild scores and may be expected to have greater change due to regression toward the mean. Using percent change instead of overall change allowed for control of baseline VHI measures. In fact, percent change was greater in the mild category (0.39) than in the moderate (0.29).

As the level of higher education increased, so did the percent change in VHI score, meaning these patients were more likely to see an improvement in VHI scores after six months. Two previous studies investigated education levels and voice. One study examined education level as a predictor of dysphonia and found an association between college or post graduate level education and a greater likelihood of chronic dysphonia.⁴⁵ Another looked at adherence level to voice treatment and found no association between education level and adherence to voice therapy.⁵¹ In general, the association between education level and health has been well studied with an overall majority of reports demonstrating that individuals with higher levels of education are healthier people with lower mortality rates.^{52,53} Further investigation of how education level influences treatment outcomes is warranted.

Per our analysis, treatment was not a predictor of change in voice handicap index after six months. More than half of the study cohort did not have additional treatment after evaluation. At this evaluation, it is possible that trial therapy or other recommendations (e.g., vocal hygiene behaviors) may have been provided. Therefore, those in the non-treatment group may have had some treatment. Change in patient-centered outcomes was not driven by additional treatment and may be more reflective of the multidisciplinary, specialty voice care patients received. Two recent studies have highlighted the importance of the ENT and SLP multidisciplinary approach, with results demonstrating greater use of videostroboscopy, increased likelihood of subsequent voice therapy, better therapy attendance, improved therapy outcomes and fewer lost billable hours due to patient no-shows.^{54,55} Unfortunately, it is estimated that less than five percent of outpatients with voice or other laryngeal disorders seen by an ENT also have SLP evaluation.⁵⁴

A limitation to this study is the overall response rate for patients returning longitudinal surveys at 35%. Research has shown reluctant respondents are more likely to be older and less educated; factors such as occupation, income and race are more unpredictable.⁵⁶ Race was not a factor considered in our study. Income and age were not predictors of change in VHI score, but higher education level was. In light of 65% of patients not returning surveys, our result of higher education level as a predictive factor for change in VHI may not be representative of the overall patient population. To mitigate these concerns, a prospective long-term patient-centered outcomes investigation is warranted. As a secondary data source, there is typically high external validity, as it arguably reflects the typical model in current clinical practice with large sample sizes. As a tradeoff, limitations exist which weaken internal validity, including data being collected from multiple practitioners. Nevertheless the findings of this study serve as a source for the development of a prospective line of clinical research.

Conclusions

Factors predicting long-term patient-centered outcomes are not well understood. Our analysis suggests education level and initial patient-perceived vocal impact on VHI may influence perceived successful outcomes from the patient perspective. Additional treatment, whether medical and/or behavioral was not a significant factor for improvement in VHI. Future studies examining the relationship between treatment patterns and voice-related patient outcomes are needed for further understanding of this phenomenon and to optimize clinical care. In the meantime, clinical considerations of these results can help set treatment recommendations for patients receiving voice intervention.

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Table 1Baseline and six month VHI and SF-12v2 ^a scores (n = 80)^b

Measure	Baseline mean (SD)	Six months mean (SD)
Mental Component Summary (SF-12v2)	50.6 (8.2)	51.2 (8.5)
Physical Component Summary (SF-12v2)	49.4 (9.7)	48.2 (10.5)
Voice Handicap Index (total)	25.9 (23.8)	19.4 (18.8)

^aScores for MCS and PCS of SF-12v2 range from 0–100; 50 is the U.S. normalized average^b2 of the 82 patients did not have complete scores for SF-12v2 or VHI

SF = short form; VHI = voice handicap index; SD = standard deviation; MCS = mental component summary; PCS = physical component summary

TABLE 2

Baseline characteristics of patients included in the study (n = 82)

Characteristic	Treatment ^a (n = 38)	No Treatment ^a (n = 44)	P
Age, mean (SD)	61.4 (15.8)	56.3 (17.3)	0.60
Female, n (%)	20 (52.6)	32 (72.7)	0.07
Smoking history, n (%)	22 (57.9)	20 (45.5)	0.28
Diagnosis, n (%)			0.76
Benign laryngeal	21 (55.3)	21 (47.7)	
Chronic laryngitis	11 (28.9)	16 (36.4)	
Neurologic	6 (15.8)	7 (15.9)	
^b Grade (G of GRBAS), n (%)			0.04
< 2	18 (47.4)	29 (65.9)	
2	19 (50)	11 (25)	
VHI category, n (%)			0.72
Normal	17 (44.7)	22 (50)	
Mild	12 (31.6)	9 (20.5)	
Moderate	5 (13.2)	7 (15.9)	
Severe	4 (10.5)	6 (13.6)	
Comorbidity score, mean (SD)	0.5 (1.5)	1.1 (1.9)	0.13
^c Bachelor's degree (%), mean (SD)	35.1 (18.3)	39.4 (20.0)	0.59
^c Mean Income (\$), mean (SD)	76,852 (22,128)	77,693 (22,379)	0.95

^aTreatment defined as behavioral and/or medical treatment received following initial evaluation^bFive patients did not have GRBAS ratings (n, treatment = 37; n, no treatment = 40).^cSocioeconomic factors collected via American Community Survey (ACS)

SD = standard deviation; GRBAS = grade, roughness, breathiness, asthenia, strain; VHI = voice handicap index

TABLE 3

Laryngeal sub-diagnoses

Category	Diagnoses
Benign laryngeal disorders	Benign vocal fold lesions (nodules, polyps, cysts), Reinke's edema, papilloma, vocal fold scar/sulcus, presbylaryngis, muscle tension dysphonia,
Chronic laryngitis	Laryngitis, laryngopharyngeal reflux, cough, paradoxical vocal fold motion disorder
Neurologic	Spasmodic dysphonia, tremor, paralysis, neurologic disorder (e.g., Parkinson Disease)

TABLE 4Unadjusted VHI scores at baseline and six months by patient characteristics (n = 76)^a

Characteristic	Baseline mean (SD)	6 month mean (SD)	^b Percent change mean (SD)	DF	F/t value	^c R	P
Age							0.24
Sex				74	-1.5	-0.14	0.07
Male	33.0 (22.5)	22.9 (16.6)	0.09 (0.79)				
Female	24.9 (24.0)	19.7 (19.9)	-0.59 (2.32)				
Smoking history							0.49
Yes (current or past)	27.3 (24.4)	22.2 (19.8)	-0.19 (1.64)	74	-0.69		
No	28.5 (23.1)	19.5 (17.7)	-0.50 (2.19)				
Treatment (surgery or therapy)				74	0.3		0.76
Yes	26.5	24.5	-0.28 (1.95)				
No	29.2	17.5	-0.41 (1.92)				
Medication recommended				74	-0.69		0.36
Yes	28.7	21.2	-0.08 (1.14)				
No	25.6	19.9	-0.43 (2.12)				
Diagnosis				2,73	0.10		0.90
Benign laryngeal	27.6	19.1	-0.38 (2.02)				
Chronic laryngitis	21.7	18.5	-0.40 (2.18)				
Neurologic	40.1	30.6	-0.12 (1.02)				
Grade (G of GRBAS)				70	-0.52		0.60
< 2	22.1	14.3	-0.51 (2.06)				
2	35.7	32.4	-0.26 (1.82)				
VHI severity				3,72	5.32		<0.01
Normal	7.9 (5.4)	13.5 (13.5)	-1.27 (2.62)				
Mild	26.5 (6.7)	16.3 (14.5)	0.39 (0.51)				
Moderate	46.9 (6.0)	33.0 (16.3)	0.29 (0.35)				
Severe	73.8 (10.0)	40.6 (24.6)	0.42 (0.39)				
Comorbidity score							0.81
^d Bachelor's degree						-0.03	0.04

Characteristic	Baseline mean (SD)	6 month mean (SD)	<i>b</i> Percent change mean (SD)	DF	F/t value	<i>c</i> R	<i>P</i>
<i>d</i> Mean Income						0.11	0.33

a Six participants with a baseline VHI of zero were not included; unable to calculate percent change

b Categorical variables = p value based on percent change

c Continuous variables = p value based on correlation

d Socioeconomic factors collected via American Community Survey (ACS)

SD = standard deviation; GRBAS = grade, roughness, breathiness, asthenia, strain; VHI = voice handicap index, DF = degrees of freedom

TABLE 5

Multivariate analysis of predictors of change in VHI (n = 76)

Variable	DF	F	p
Bachelor's degree	1	5.44	0.02
VHI category	4,71	5.59	<0.01

VHI = voice handicap index, DF = degrees of freedom