

# Speech pathologist students: voice self-assessment, vocal symptoms and phonatory deviation diagram

Estudantes de fonoaudiologia:  
autoavaliação da voz, sintomas vocais  
e diagrama de desvio fonatório

Estudiantes de fonoaudiología:  
autoevaluación de la voz, síntomas vocales  
y diagrama de desviación fonatoria

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## Abstract

**Introduction:** speech therapists must present their voices as a model for a speech therapy intervention. **Objective:** to understand the voice self-assessment and vocal symptoms of a group of speech therapy students, relating the findings to the phonatory deviation diagram. **Method:** an analytical observational study was conducted with 88 speech therapy students from the same college, consisting of 82 women and 6 men, averaging 21.9 years old, who reported no diagnosis of dysphonia, and self-reported as healthy. Data relating to voice self-assessment and vocal symptoms were recorded and compared, using the Vocal Symptoms Scale (VoiSS). In the second stage, students were invited to perform an acoustic analysis of their voices and those who accepted (63.6%) proceeded with the collection of voice samples, using the VoxMetria® – CTS program. To process the data, the T-student Test and Correlation Matrix constructed with the results of the T-student Test (confidence level of 95%, alpha 5%) were used. **Results:** The Vocal Symptoms Scale (student T-test) revealed 44.31% of participants with raw scores equal to or greater than 16 points, indicating vocal risk and greater impairment of the physical domain. Final year students obtained higher scores, with a predominance of secretion and throat clearing. There was a positive correlation between smoking (7.95%) and an increase in the final grade. The acoustic analysis revealed 40% of the voices with a phonatory deviation diagram outside the quadrant of normal voices,

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### Author's contributions:

IBO: study conception, methodology, data collection, study outline and critical review;  
TDR: data collection, data organization, and study outline.

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voice irregularity, altered jitter, and shimmer. **Conclusion:** The combination of the two instruments used to understand the risk of dysphonia in speech therapy students is relevant and reinforces the importance of vocal health prevention programs for future speech therapists.

**Keywords:** Voice; Dysphonia; Speech Acoustic; Questionnaire; Quality of life

### Resumo

**Introdução:** considera-se importante que fonoaudiólogos apresentem suas vozes como modelo ao realizar uma intervenção fonoaudiológica. **Objetivo:** conhecer a autoavaliação da voz e sintomas vocais de um grupo de acadêmicos de fonoaudiologia relacionando os achados ao diagrama de desvio fonatório. **Método:** estudo do tipo analítico, observacional, com 88 estudantes de Fonoaudiologia de uma mesma faculdade, 82 mulheres e seis homens, média de idade de 21,9 anos, sem diagnóstico de disфония, autorreferidos saudáveis. Foram registrados e comparados dados relativos à autoavaliação da voz e de sintomas vocais, utilizando-se a Escala de Sintomas Vocais. Numa segunda etapa os estudantes foram convidados a realizar uma análise acústica de suas vozes e os que aceitaram (63,6%) procederam com a coleta das amostras de voz, programa VoxMetria® – CTS. Para tratamento dos dados foram utilizados Teste T – student e Matriz de Correlações construída com os resultados do Teste T- student (nível de confiança de 95%, alpha 5%). **Resultados:** a Escala de Sintomas Vocais revelou 44,31% dos participantes com escores brutos igual ou superior a 16 pontos, indicando risco vocal, com maior comprometimento do domínio físico. Alunos do último ano obtiveram escores mais elevados, com predomínio de secreção e pigarro na garganta. Houve correlação positiva entre fumar (7,95%) e aumento da nota final. A análise acústica revelou 40% das vozes com diagrama de desvio fonatório fora do quadrante de vozes normais, irregularidade da voz, jitter e shimmer alterados. **Conclusão:** a combinação dos dois instrumentos utilizados para conhecimento de risco de disфония em estudantes de Fonoaudiologia mostra-se relevante e reforça a importância de programas de prevenção de saúde vocal também em futuros fonoaudiólogos.

**Palavras-chave:** Voz; Disфония; Acústica da fala; Questionário; Qualidade de Vida.

### Resumen

**Introducción:** los fonoaudiólogos deben presentar su voz como modelo para realizar una intervención logopédica. **Objetivo:** comprender la autoevaluación vocal y los síntomas vocales de un grupo de estudiantes de fonoaudiología, relacionando los hallazgos con el diagrama de desviación fonatoria. **Método:** se realizó un estudio observacional analítico, observacional, con 88 estudiantes de fonoaudiología de la misma facultad, conformados por 82 mujeres y 6 hombres, con edad promedio de 21,9 años, quienes no refirieron diagnóstico de disфония y se autorefirieron como sanos. Los datos relacionados con la autoevaluación de la voz y los síntomas vocales se registraron y compararon mediante la Escala de Síntomas Vocales. En la segunda etapa, los estudiantes fueron invitados a realizar un análisis acústico de sus voces y los que aceptaron (63,6%) procedieron a la recolección de muestras de voz, utilizando el programa VoxMetria® – CTS. Para procesar los datos se utilizó la Prueba T de Student y la Matriz de Correlación, construida con los resultados de la Prueba T de Student (nivel de confianza del 95%, alfa 5%). **Resultados:** La Escala de Síntomas Vocales (prueba T de Student) reveló puntuaciones brutas iguales o superiores a 16 puntos (44,31%), lo que indica riesgo vocal y mayor afectación del dominio físico. Los estudiantes de último año obtuvieron puntuaciones más altas, con predominio de secreción y carraspeo. Hubo correlación positiva entre fumar (7,95%) y aumento en la nota final. El análisis acústico reveló voces presentando diagrama de desviación fonatoria fuera del cuadrante de normalidad (40%), irregularidad de la voz, jitter y shimmer alterados. **Conclusión:** La combinación de los dos instrumentos utilizados para comprender el riesgo de disфония en estudiantes de fonoaudiología es relevante y refuerza la importancia de los programas de prevención de la salud vocal para futuros fonoaudiólogos.

**Palabras clave:** Voz; Disфония; Acústica del habla; Cuestionario; Calidad de Vida.

## Introduction

As an essential tool for effective communication, voice becomes even more important for those who use it professionally. Certain groups of professionals, such as teachers, actors, singers, and others who use their voices as a primary work tool, have an increased risk of developing vocal disorders<sup>1</sup>.

Speech-language pathologists are recognized as professionals skilled in promoting vocal health and effectiveness for those who need their voices for their profession. In this sense, many studies have been conducted to evaluate, monitor, and develop programs aimed at the vocal health of future speech-language pathologists, considering the importance of these professionals presenting as vocal models during speech-language pathology intervention<sup>2,3,4,5</sup>.

Increased vocal demands at the beginning of a professional career can heighten the frequency of symptoms, significantly impacting the quality of life and professional performance of these individuals. It is crucial to evaluate a voice understood in its aspects of self-perception of the voice, in addition to other analysis such as the auditory-perceptual and acoustic of the voice<sup>6</sup>.

Self-assessment of voice and voice-related quality of life measures have been valued for understanding the complex mechanisms involved in voice production and its disorders. In this context, some authors emphasize the importance of validating instruments for this purpose, which has been occurring in Brazil<sup>7,8</sup>.

One such measure is the Voice Symptom Scale (VoiSS), translated and culturally adapted to Brazilian Portuguese, considered a robust self-assessment tool for voice and vocal symptoms. The VoiSS provides information on functionality, emotional impact, and physical symptoms caused by a voice problem. It comprises nine factors: emotional, functional, vocal performance, secretion, voice sound, throat sensation, vocal pleasantness, vocal instability, and singing voice<sup>8</sup>. The VoiSS includes 30 questions: fifteen on functional limitations, eight on the psychological and emotional effects of a possible voice problem (emotional domain), and seven on the physical domain<sup>8,9</sup>.

The cutoff value for the VoiSS is 16 points, distinguishing an average total score of 7.11 points for the general population without vocal complaints and 49.43 points for people with dysphonia<sup>9</sup>.

Acoustic measures have also been identified as important tools in voice assessment. Among these, the Phonatory Deviation Diagram (PDD) contributes to the complement of an evaluation, among other resources. For this study, it is emphasized that the Phonatory Deviation Diagram quantitatively evaluates the periodicity of the noise in the sound signal, allows for the extraction of acoustic measures, and provides the distribution of the vocal sample in the Phonatory Deviation Diagram. The program allows for a graphical illustration of voice quality, which can be easily interpreted<sup>10</sup>. The diagram is based on four acoustic measures: three related to signal irregularity – jitter, shimmer, and harmonic-to-noise ratio; and the fourth, the noise component, called the glottal-to-noise excitation ratio (GNE). In addition to enabling the monitoring of vocal quality, the PDD can identify differences among groups of dysphonic individuals with different phonatory mechanisms<sup>11,12</sup>. It also shows a significant relationship between perceptual-auditory analysis and the positioning of voices on the phonatory deviation diagram, within or outside normal limits<sup>12,13</sup>.

Therefore, this study aimed to understand the self-assessment of voice and vocal symptoms in a group of Speech-Language Pathology students, relating the findings to the phonatory deviation diagram.

## Methods

This is an observational, analytical, and prospective study, utilizing data captured and stored in a database (Excel spreadsheets) regarding acoustic voice analysis, self-assessment of voice, and vocal symptom reports from a group of 88 university students (82 women and 6 men, average age 21.9 years), all studying at the same Speech-Language Pathology course. All participants reported having no vocal disorder diagnosis at the time of the study and declared themselves healthy.

They were informed about the study's proposals and signed the Informed Consent Form in duplicate. This database is part of a larger study involving subsequent voice training for Speech-Language Pathology students. It was approved by the Research Ethics Committee of the Institution under the Decision No. 1.297.600, registered in the CAAE [*Certificate of Presentation for*

*Ethical Consideration*] Plataforma Brasil No. 47955515.8.0000.5481.

It is important to highlight that at the time of compiling the database, the Speech-Language Pathology course involved in this study consisted of a four-year program divided into eight terms. The years in which the subjects were enrolled were considered for analysis purposes.

Data related to the self-assessment of vocal symptoms were recorded and compared using the Voice Symptom Scale (VoiSS), considering its domains of Functional Limitation, Emotional, and Physical aspects<sup>8,9</sup>. The response options for the frequency of symptoms were: never (zero points), rarely (one point), sometimes (two points), almost always (three points), and always (four points). The total score is the sum of scores from the three domains<sup>9</sup>.

After completing the mentioned scale, these students were invited to participate in a second stage of the study, aimed at conducting an acoustic analysis of their voices. Fifty-six students (63.6%

of the initial sample) accepted and were able to participate in this procedure. Voice samples were collected in an acoustically controlled room, using the sustained vowel /ε/ with a headset microphone placed five centimeters from the participant's mouth. The voice samples were directly recorded onto a Sony Vaio notebook, Windows 2010, using the Voxmetria 4.0 software. All voice samples were edited to three seconds, excluding the initial and final moments of emissions. Subsequently, phonatory deviation diagrams were extracted from the voice samples for analysis and comparison.

## Results

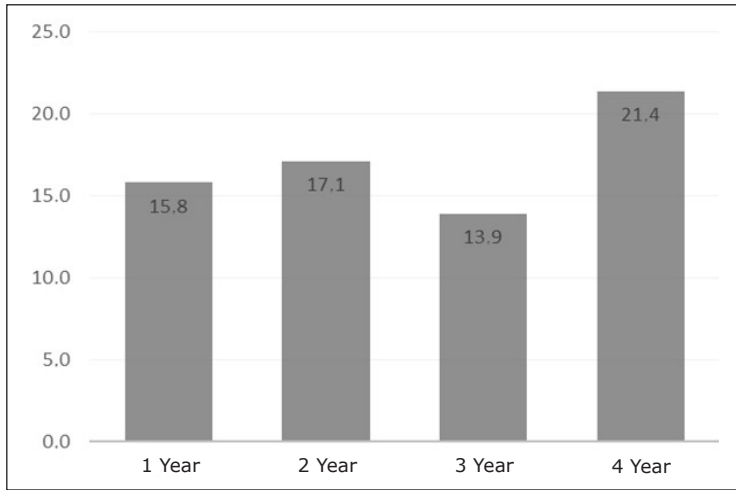
The sample in the first part of the study, where the Voice Symptom Scale (VoiSS) was applied, consisted of 88 subjects, with 93.2% women and 6.8% men. Seven students (7.95%) reported being smokers.

Table 1 shows the distribution of the subjects based on their enrolled years.

**Table 1.** Distribution of subjects by year enrolled in Speech-language pathology

Academic Year	Students distributed by academic year	
	n	%
First	27	30.68
Second	20	22.73
Third	24	27.27
Fourth	17	19.32
Total	88	100

Figure 1 presents the average raw scores obtained from the responses to the Voice Symptom Scale, grouped by the four years of the course.



**Figure 1.** Voice Symptom Scale: Mean raw scores obtained across the four years of the speech-language pathology course.

Tables 2 and 3 respectively show the results related to the average raw scores in the three domains of the Voice Symptom Scale (functional limitation,

emotional, and physical) and the descriptive analysis of each question in the instruments.

**Table 2.** Mean raw scores in the three domains of the Voice Symptom Scale obtained in each year of the speech-language pathology course.

Academic Year	Domain Averages		
	Limitation	Emotional	Physical
First	8.9	0.6	6.4
Second	9.0	1.2	7.7
Third	6.5	1.1	6.6
Fourth	11.6	1.3	8.5

**Table 3.** Means and medians obtained for the questions of the Voice Symptom Scale

Variable	#	Min.	Max	Mean	Median	Mode	Variance	Standard Deviation
Smoker	88	0	1	0,091	0	0	0,084	0,289
L1 - Do you have problems calling people's attention?	88	0	4	0,750	0	0	0,856	0,925
L2 - Do you have problems singing?	88	0	4	1,239	1	0	1,563	1,250
L4 Is your voice hoarse?	88	0	2	0,580	0	0	0,522	0,723
L5 - When you talk with a group of people, do they have difficulties hearing you?	88	0	3	0,648	0	0	0,668	0,817
L6 - Do you lose your voice?	88	0	2	0,511	0	0	0,437	0,661
L8 - Is your voice weak/low?	88	0	4	0,557	0	0	0,824	0,908
L9 - Do you have problems speaking on the phone?	88	0	3	0,182	0	0	0,242	0,492
14 - Do you get tired talking?	88	0	3	0,773	0	0	0,890	0,944
L16 - Do you have difficulties speaking in noisy environments?	88	0	4	0,989	1	0	1,092	1,045
L17 - Is it difficult to talk strong (high) or to yell?	88	0	3	0,670	0	0	0,959	0,979
L20 - Does the sound of your voice change during the day?	88	0	3	0,511	0	0	0,575	0,758
L23 - Do people ask you what is wrong with your voice?	88	0	1	0,057	0	0	0,054	0,233
L24 - Does your voice seem hoarse and dry?	88	0	2	0,352	0	0	0,369	0,607
L25 - Do you have to make an effort to speak?	88	0	2	0,409	0	0	0,428	0,655
L27 - Does your voice fail in the middle of a sentence?	88	0	2	0,477	0	0	0,413	0,643
E10 - Do you feel bad or depressed due to your voice problem?	88	0	4	0,091	0	0	0,222	0,471
E13 - Do you feel embarrassed due to your voice problem?	88	0	3	0,136	0	0	0,257	0,507
E15 - Does your voice problem make you stressed or nervous?	88	0	2	0,170	0	0	0,258	0,508
E18 - Does your voice problem bother your family or friends?	88	0	2	0,136	0	0	0,165	0,406
E21 - Do people seem to get irritated with your voice?	88	0	2	0,239	0	0	0,299	0,547
E28 - Does your voice make you feel incompetent?	88	0	1	0,057	0	0	0,054	0,233
E29 - Are you ashamed of your voice problem?	88	0	1	0,057	0	0	0,054	0,233
E30 - Do you feel lonely because of your voice problem?	88	0	2	0,057	0	0	0,077	0,278
P3 - Does your throat hurt?	88	0	4	1,080	1	1	0,787	0,887
P7 - Do you cough or clear the throat?	88	0	4	1,420	1	1	1,120	1,058
P11 - Do you feel something stuck in your throat?	88	0	4	0,659	0	0	1,055	1,027
P12 - Do you have swollen nodules in your neck?	88	0	3	0,273	0	0	0,454	0,673
P19 - Do you have a lot of secretion or phlegm in your throat?	88	0	4	0,875	1	0	1,030	1,015
P22 - Do you have stuffy nose?	88	0	4	1,477	1	{1,2}	0,988	0,994
P26 - How often do you have throat infections?	88	0	3	1,261	1	1	0,517	0,719
Age	88	17	52	21,898	21	20	25,288	5,029
Year	88	1	4	2,352	2	1	1,242	1,115

Abbreviation: L= Limitation; E= Emotional; P= Physical; Note: The table presents the questions from the Voice Symptoms Scale grouped by domains. For the full text of the questions, refer to: Moreti F; Zambom F; Oliveira G.; Behlau M. Equivalência cultural da versão Brasileira da Voice Symptom Scale: VoiSS. J. Soc. Bras. Fonoaudiol. 2011<sup>8</sup>.

Table 4 shows the number and percentages of students classified above and below 16 points, the cutoff that indicates pass or fail in the VoiSS.

**Table 4.** Number and percentage of students above and below the cutoff point of the VoiSS

Voice Symptom Scale	1st Year		2nd Year		3rd Year		4th Year		Total	
	N	%	N	%	N	%	N	%	N	%
Above Cutoff	12	44	9	45	6	25	10	59	37	42
Below Cutoff	15	56	11	55	18	75	7	41	51	58
Total	27	100	20	100	24	100	17	100	88	100

Table 5 presents the final classification results of the acoustic analysis performed on 56 out of the initial 88 students who agreed to undergo the acoustic examination. Numbers and percentages of the results are distributed by the years studied. The quadrants of the Phonatory Deviation Diagram of

the students were categorized into Normal (Lower Left Quadrant) and altered: Lower Right Quadrant (LRQ) compatible with breathy voices, and Upper Right Quadrant (URQ) compatible with more affected voices.

**Table 5.** Phonatory Deviation Diagram of the 56 Students

Phonatory Deviation	1st Year		2nd Year		3rd Year		4th Year		Total	
	N	%	N	%	N	%	N	%	N	%
LRQ	2	15	10	63	8	47	0	0	20	36
URQ	0	0	0	0	0	0	2	20	2	4
Normal	11	85	6	38	9	53	8	80	34	61
Total	13	100	16	100	17	100	10	100	56	100

Abbreviation: LRQ=Lower Right Quadrant; URQ= Upper Right Quadrant.

Table 6 shows the altered acoustic parameters in the group of 56 students who agreed to undergo acoustic analysis.

**Table 6.** Number of students and percentage with alterations in acoustic parameters

Acoustic Parameters	1st Year		2nd Year		3rd Year		4th Year		Total	
	N	%	N	%	N	%	N	%	N	%
IRR/SH	0	0	0	0	1	6	0	0	1	2
IRR	0	0	5	31	3	18	0	0	8	14
IRR/GNE	0	0	0	0	0	0	1	10	1	2
IRR/GNE/JI	0	0	0	0	0	0	1	10	1	2
IRR/JI	1	8	2	13	1	6	0	0	4	7
IRR/JI/SH	0	0	2	13	0	0	0	0	2	4
IRR/SH	1	8	1	6	2	12	0	0	4	7
Normal	11	85	6	38	10	59	8	80	35	63
Total	13	100	16	100	17	100	10	100	56	100

Abbreviation: IRR= Irregularity; Sh=shimmer; JI=jitter; GNE= glottal to noise excitation



## Discussion

This study aimed to investigate the vocal symptoms among Speech-Language Pathology students at a private university in the State of São Paulo, in Brazil. The vast majority of participants were female (93.0%), with a mean age of 21.9 years. However, there was a significant increase in the mean age within the subgroup of second-year students, which was explained by the presence of one subject aged 56.

Speech-language pathologists are voice professionals who, among other functions, treat vocal disorders. A study involving 142 speech-language pathologists showed that these professionals report significant vocal symptoms, such as effort when speaking, dry throat, and pain, with vocal fatigue being reported by 71.13% of the participants. These symptoms were associated with prolonged periods of voice use for recreational purposes, speaking loudly, frequent clearing of the throat, inadequate hydration, and working in noisy environments or with air conditioning.

Smoking, which was reported in the present study among 7.95% (eight students) of the participants, has been identified as having serious consequences for voice and laryngeal health. Smoking is associated with changes in vocal quality, laryngeal discomfort, and other tissue alterations<sup>15</sup>.

The study has a cutoff score of 16 points for the VoiSS as an indicative of risk for developing vocal disorders<sup>8,9</sup>. According to these researchers, “this value can be used as a pass or fail criterion in screening.” In the present study, the results show that students in the second and fourth years have scores above the cutoff point of the scale. Therefore, on average, it can be considered that these students have failed, indicating a risk of voice disorder (42%). It should be emphasized that the practical involvement of students in clinical internships for speech-language pathology therapy at this university begins in the third year, where vocal use becomes more demanding. Therefore, there is no apparent relationship between vocal use associated with these internships, as evidenced by the fact that second-year students obtained higher scores on the symptom scale. This possibility could be considered in the case of scores obtained by fourth-year students, whose average raw score was the highest and significantly so (average of 21.4 points). In this scenario, it should be noted that these students are

intensifying their vocal use, likely due to engaging in extracurricular internships, which could indeed be associated with the high occurrence of vocal symptoms.

Overall, voice professionals often face a high prevalence of vocal symptoms, lack of information, and inadequate knowledge about voice, which can promote improper vocal use. Therefore, like other studies<sup>16,17</sup>, the findings of this study indicate the need for individuals to value their vocal symptoms and laryngeal sensations, as well as to identify risk factors for vocal disorders, aiming for effective protection of their own voice. It is further highlighted the high prevalence of vocal symptoms observed among fourth-year speech-language pathology students, who have sufficient theoretical training to recognize voice care. It appears that theoretical training alone may not be sufficient, which raises awareness for proposals of vocal education programs involving practical experiences and consciousness-raising activities.

In this study, vocal symptoms with a significant frequency of occurrence were: “do you cough or clear your throat?” and “do you have a stuffy nose?” Other research involving university students also shows that clearing the throat is among the symptoms significantly present in this population<sup>17,18</sup>. In research on aspects related to throat clearing among university students, probable causes included smoking, frequent respiratory infections, and digestive problems. Throat clearing can also be linked to poor vocal habits<sup>16</sup>.

The Phonatory Deviation Diagram (PDD) is an acoustic analysis tool that uses combined parameters and graphical representation to provide a reliable description of vocal quality. It can differentiate between groups with vocal disorders by indicating phonatory mechanisms present in vocal production<sup>19</sup>. In this study, this tool confirmed differential patterns between healthy voices and those with impairments (Table 3) in 40% of students showing altered PDD, predominantly indicating a LRQ consistent with breathy voices. Upon closer analysis, irregularity parameters were notably altered in graphical representations of LRQ voices. There were four voices identified in the URQ considered to be more severely affected. Thus, the cutoff point of 16 points indicating failure in the VoiSS can be confirmed with the inclusion of acoustic analysis using the PDD tool, which



raises concerns regarding the vocal health of future speech-language pathologists.

The findings of this study are in line with research conducted on 197 speech-language pathology students in the United States, covering subjects from the first year to the final year of the course. The study reported vocal symptom complaints among participants, showing that more than half of these subjects were considered “borderline” on the dysphonia severity scale. There were no differences in vocal parameters assessed related to the academic year, highlighting the high vocal demand that speech-language pathologists face in their profession<sup>3</sup>.

This underscores the necessary attention that should be given to future professionals who will work in communication health for the general population. In addition to the theoretical education and practical experiences gained through internships, particularly in vocal therapy, these speech-language pathology students would undoubtedly benefit from customized vocal programs and guidance tailored to their needs. Among other initiatives, it is important to highlight a study that developed a vocal warm-up program for speech-language pathology students, which showed positive impacts on the voice quality of these students<sup>4</sup>.

This study was focused on analyzing results obtained from the application of the Vocal Symptoms Scale (VoiSS) among students at a Speech-Language Pathology course, involving participants from all four years of the program, and it aimed to validate these results using other acoustic analysis methods. However, a limiting factor was the absence of perceptual-auditory analysis of the participants’ voices and the lack of use of voice-related quality of life protocols, which could have provided greater robustness to the data obtained.

## Conclusion

The combination of the two instruments used to assess the risk of dysphonia in speech-language pathology students, namely, the Vocal Symptoms Scale and acoustic analysis, proves to be relevant and confirms the vocal risk within a significant portion of the study group. This underscores the importance of customized vocal health prevention programs tailored for future speech-language pathologists.

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