

Aging Voice Index (AVI): Reliability and Validity of a Voice Quality of Life Scale for Older Adults

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Summary: Changes in voice in aging adults impact their ability to use their voice to communicate in all situations and can lead to decreased quality of life (QOL). The primary objective of this study was to determine the validity and reliability of the Aging Voice Index (AVI)—a tool specifically designed for aging adults with voice disorders. A total of 92 older adults were asked to complete the Voice-Related Quality of Life Scale (VRQOL) and the AVI as well as provide their self-perceived voice severity rating of their voice problem and demographic information. Intraclass correlation for test-retest reliability was 0.952. The AVI was highly correlated to the VRQOL ($P < 0.0001$). Additionally, the AVI score was found to distinguish between self-rated voice quality ($P < 0.0001$) and diagnostic voice categories ($P < 0.0001$). No significant differences were identified for sex or race. The AVI is a valid and reliable quality of life assessment for older adults with voice disorders. The AVI will capture the quality of life impact a voice disorder has on older adults. Future studies will further explore differences in clinical diagnoses and identify clinically significant changes in pre-to post-AVI scores.

Key Words: Aging—Voice—Quality of life—Instrument development—Presbylaryngis.

INTRODUCTION

Using voice to communicate and participate in everyday activities is essential for maintaining a good quality of life throughout the life span. Adults use their voices for social enjoyment, vocation, and participation in daily activities. Unfortunately, many older adults experience physiologic alterations in their vocal mechanisms, limiting the efficiency, quality, and overall ability to use their voices for all their communication wants and needs.^{1–3} Standard voice evaluations are composed of several direct visual and indirect perceptual assessment measures, including obtaining self-rated quality of life scores from the patient. To the best of our knowledge, there is no valid and reliable voice-related quality of life index for older adults.⁴

It is estimated that 6.6% of the general population under 65 years of age currently has a voice disorder,⁵ whereas as many as 20%–29% of individuals over the age of 64 may currently have a voice disorder.^{2,6} Of individuals seeking treatment for their voice disorder, more than 25% are over the age of 65 years.⁷ Considering that by the year 2030, one-fifth of the U.S. population will be over 65 years, accurate assessment and treatment of the aging population is extremely important. A complete assessment includes an in depth understanding of the ways in which a voice disorder may impact the social participation and quality of life.

Dysphonia can lead to quality of life changes in social, functional, physical, and emotional aspects and interfere in almost all activities of daily living, communication, and employment^{3,8–10}; the magnitude of impact of a voice disorder may even be further increased in an aging population.⁸ Many studies have considered the quality of life impact of voice disorders in the older population.^{8,9} In a work by Verdonck-de Leeuw and Mahieu, longitudinal data were collected from 11 healthy men from age 50 to 81 over a 5-year period. Investigators reported a gradual change in voice with aging, such as vocal fatigue, hoarseness, and a rough quality of voice. Participants noted this change in voice had a significant impact on daily life.⁹

A number of tools have been developed to consider the quality of life impact of voice disorders, including the Voice Handicap Index (VHI),¹¹ Voice Handicap Index-10 (VHI-10),¹² Voice-Related Quality of Life (V-RQOL),¹³ Voice Activity and Participation Profile,¹⁰ the Voice Symptom Scale,¹⁴ and the Voice Outcome Survey.¹⁵ Most of these scales have been designed for the working-age population (under 64 years). However, the V-RQOL and VHI have been adapted for the pediatric population (pV-RQOL and pVHI).^{16,17} Other quality of life instruments have been developed for a specific diagnostic classification (eg, vocal fold paralysis, head and neck cancer).^{18,19} Currently, there are no validated instruments for assessing the quality of life impact of voice disorders in older adults with dysphonia. As a result, clinicians and researchers lack a critical resource for the comprehensive assessment of voice disorders in older individuals. Treatment studies with aging populations have been able to observe an increase in self-reported quality of life for older adults after voice therapy using scales designed for a younger population such as the V-RQOL²⁰ and the VHI²¹; however, work by Ziegler and colleagues may suggest improvements in quality of life may not be strongly related to treatment adherence.²² It is possible that some, but not all, elements of the experiences of older adults

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with voice disorders are captured by currently available scales. This is not surprising as current scales were not developed or validated using an aging adult population.²³

Scale development

In a systematic review of patient-reported outcome measures (PROMs), Branski and colleagues evaluated the content development of currently available voice quality of life scales.²³ Using guidelines for scale development outlined by a report from the Scientific Advisory Committee of the Medical Outcome Trust and a guidance document from the Food and Drug Administration (FDA), the authors concluded the lack of strong psychometric properties of the current voice-related PROMs may be, at least in part, due to deficits in the development process. The authors suggest development of question items begin from a client-centered approach using patient interviews in contrast to question items generated from expert opinion alone. Items can then go through a series of item reduction and language modifications, dependent upon the needs of the population of interest. Currently available tools for voice quality of life have all completed some degree of the recommendations noted by Branski and colleagues, but none have addressed the specific needs of an older population.

The Aging Voice Index (AVI) is the product of a multi-phase scale development process informed by the FDA guidance document and the Scientific Advisory Committee of the Medical Outcome Trust report.²³ As described in Etter et al, the first such study obtained rich information regarding the thoughts and feelings of older adults with voice disorders.²⁴ Using semistructured interviews and qualitative phenomenological methodologies, specific concerns of aging adults with dysphonia were captured. These ideas were organized into categories and themes and presented to a separate group of older adults with voice disorders as a reliability check. The six themes identified by the initial group of older adults with voice disorders included that they (1) wanted people to understand them when they talked, (2) felt hindered because of their voice, (3) took more energy to speak, (4) did not like the way their voice sounded, (5) were emotionally affected by their voice, but (6) tried not to let their voice affect what they wanted to do. Participants in the separate group of older adults confirmed the themes were consistent with their experiences.

The next step in scale development was to generate a list of questions consistent with the themes generated and validated in the first two stages. Using the information from the semistructured interviews, a 36-item questionnaire was developed for use in the study. In a third phase of the study, a novel group of treatment-seeking adults completed beta testing of the long scale for two primary purposes: item reduction and readability assessment. After completing the third stage, the 36 items were reduced to 23 questions and, based on participant feedback, minor changes were made to increase readability of the newly designed AVI. The aim of this study is to determine the reliability and validity of the AVI.

MATERIALS AND METHODS

Adults seeking treatment for a voice disorder and individuals without a history of voice problems (healthy controls) were recruited to determine the reliability and validity of the AVI. The complete set of AVI question items is presented in [Table 1](#). Participants were recruited from universities and voice centers located in Kentucky, Georgia, Utah, and two sites in Pennsylvania. A total of 92 adults ranging from 60 to 92 years (mean 71.1 years; 38 men/54 women) passed the MiniCog,²⁵ provided consent, and participated in this study. The MiniCog was used as a brief screener for cognitive impairments. All participants with and without voice disorders followed the same assessment protocol.

Participants were asked to complete a series of surveys regarding the emotional, vocational, or participatory impact of their voice disorder, including a Voice Quality Self-Rating Scale, the V-RQOL,¹³ and the AVI. Participants were given the option to skip or decline any questions they did not wish to answer. The Voice Quality Self-Rating Scale collected participant data including demographic data regarding age, sex, and race. Additionally, each participant was asked to rate their self-perceived voice quality. Rating options included normal, mildly dysphonic, moderately dysphonic, moderate to severely dysphonic, and severely dysphonic. Participants were educated, in advance, as to the terminology of dysphonia. For the treatment-seeking group, the treating otolaryngologist provided the primary voice diagnosis.

To validate the AVI against a currently used valid and reliable voice scale, participants were asked to complete the V-RQOL.¹³ The V-RQOL is a 10-question scale where individuals rate the level of severity or impact their voice problem may have on their everyday life. Participants respond to each stimulus with a rating between 1 and 5, with 1 indicating their voice causes them no problems whatsoever and 5 being the problem is "as bad as it can be." For this severity scale, scores can range from 10 to 50.

Finally, participants completed the newly developed scale designed for age-related voice disorders, the AVI. The AVI is a 23-item quality of life survey that asks the patient to indicate how often each statement occurs in their daily life, using the following choices: never, rarely, sometimes, usually, or always. These ratings translate to scores from 0 to 4, respectively, and a sum total or score is achieved. Therefore, a higher total value indicates a greater impact to quality of life. The maximum score on the AVI is 92. To complete test-retest reliability, participants were asked to complete the AVI a second time. They either completed the AVI a second time in office after at least 1 hour between testing or were given a self-addressed envelope and asked to return the second AVI within 1 week.

Statistical analysis

Each participant's sum scores for AVI test 1, AVI test 2 (if available), and V-RQOL raw score were used for comparisons, along with their responses for self-reported voice quality, sex, race, and age. A Cronbach coefficient alpha was used to determine internal consistency or scale reliability for the AVI. Pearson

TABLE 1.
Aging Voice Index

Aging Voice Index (AVI)	0	1	2	3	4
1 People ask, "What's wrong with your voice?"	Never	Rarely	Sometimes	Usually	Always
2 Because of my voice problem, people can't hear me.	Never	Rarely	Sometimes	Usually	Always
3 My voice problem frustrates me.	Never	Rarely	Sometimes	Usually	Always
4 My voice problem causes me to run out of air when I talk.	Never	Rarely	Sometimes	Usually	Always
5 I am frustrated by the changes in my voice.	Never	Rarely	Sometimes	Usually	Always
6 People think I'm sick because of my voice problem.	Never	Rarely	Sometimes	Usually	Always
7 Because of my voice problem, I speak less.	Never	Rarely	Sometimes	Usually	Always
8 It takes effort for me to speak.	Never	Rarely	Sometimes	Usually	Always
9 It annoys me when my voice doesn't work well.	Never	Rarely	Sometimes	Usually	Always
10 My voice problem affects what I want to do.	Never	Rarely	Sometimes	Usually	Always
11 People make negative judgments about me based on my voice.	Never	Rarely	Sometimes	Usually	Always
12 I worry about my voice.	Never	Rarely	Sometimes	Usually	Always
13 I had to stop taking part in an activity that is important to me because of my voice problem (singing, volunteer, work, etc).	Never	Rarely	Sometimes	Usually	Always
14 Because of my voice problem, other people talk for me.	Never	Rarely	Sometimes	Usually	Always
15 I don't like the way my voice sounds.	Never	Rarely	Sometimes	Usually	Always
16 My voice problem makes me sad.	Never	Rarely	Sometimes	Usually	Always
17 I completely lose my voice.	Never	Rarely	Sometimes	Usually	Always
18 I feel hindered (held back) because of my voice problem.	Never	Rarely	Sometimes	Usually	Always
Even though I have a voice disorder, ...	4	3	2	1	0
19 I talk on the telephone as much as I want.	Never	Rarely	Sometimes	Usually	Always
20 I like the way my voice sounds.	Never	Rarely	Sometimes	Usually	Always
21 I can talk as much or long as I want.	Never	Rarely	Sometimes	Usually	Always
22 My family and close friends understand me when I talk.	Never	Rarely	Sometimes	Usually	Always
23 My voice is as good as I want it to be.	Never	Rarely	Sometimes	Usually	Always
Total					/92

correlations were used to determine how strongly associated the AVI was to retest and to VRQOL scores. Intraclass correlations were used to provide a second assessment of test-retest reliability for AVI test 1 and test 2 scores. Finally, least mean squares using Tukey test to adjust for multiple comparisons were used to identify difference in AVI mean scores by voice diagnostic category, self-reported voice quality, race, and sex.

RESULTS

Ninety-six adults, 60+ years, were recruited for this study. Of the participants recruited, four participants failed the MiniCog and therefore were unable to continue with the study. A total

of 92 adults completed initial study procedures, with a total of 84 participants (92.3%) completing the second testing of the AVI for test-retest reliability data. Of the 84 participants who completed the retest of the AVI, 54 mailed in their self-addressed envelope and 40 completed the retest in office. Demographic data are reported in Table 2.

There was no significant difference on mean AVI score by race ($P=0.2226$) or sex ($P=0.6494$). Treating otolaryngologists provided the primary voice diagnosis for each experimental participant that was organized post hoc into five diagnosis categories. Diagnosis categories included (1) primary muscle tension dysphonia, (2) benign midmembranous vocal fold lesions, (3) neurogenic diagnosis (including individuals with

TABLE 2.
Age, Sex, and Race Demographic Data of AVI Participants and Percentage Complete of Test-Retest Methods

	Test-Retest	Age	Sex	Race
Healthy controls (n = 20)	20/20 100%	71.6 (60–92)	M: 7 F: 13	White: 19 Declined: 1
Voice patients (n = 72)	64/72 89%	70.7 (60–91)	M: 31 F: 41	White: 69 Asian: 1 Black or African American: 1 American Indian/Alaska Native: 1
Total (n = 92)	84/92 91%	71.1 (60–92)	M: 38 F: 54	

TABLE 3.
Mean AVI Score by Diagnostic Category

Diagnosis Category	No. of Respondents	Mean AVI Score (0–92)	Standard Error	Mean VRQOL (10–50)	Standard Error
Normal	20	6.050	3.167	11.421	1.441
Primary muscle tension dysphonia	3	40.667	8.179	25.000	3.628
Benign midmembranous vocal fold (BMFL)	9	26.889	4.722	15.778	2.095
Neurogenic	14	38.785	3.786	23.071	1.680
Presbylaryngis	40	37.825	2.257	20.900	0.994
Inflammatory	6	24.500	5.783	14.500	2.565

Parkinson disease and tremor), (4) presbylaryngis-atrophy, and (5) inflammatory. The “inflammatory” diagnosis category included diagnoses of laryngopharyngeal reflux and Reinke edema. Participants with no self-reported history of voice disorders were categorized as “normal.” Table 3 lists the number of participants in each category. There was a significant group difference on mean AVI score between participants seeking treatment for a voice disorder and those under the “normal” diagnosis category ($P < 0.0001$). Post hoc analyses using Tukey test and adjusted for multiple comparisons identified a significant difference between the “normal” diagnosis category and all voice diagnostic categories, except individuals with an “inflammatory” diagnosis. No other significant differences between diagnostic categories were identified. See Figure 1 for AVI mean score by diagnosis and Table 3 for means and standard errors by diagnostic category. Scores on the AVI can range from 0 to 92, with higher values indicating increased impact of the voice disorder.

All participants were asked to self-report their perceived voice quality from “normal” to “severe.” Participants responded as: normal ($n = 21$), mild ($n = 18$), mild to moderate ($n = 9$), moderate ($n = 16$), moderate to severe ($n = 16$), and severe ($n = 4$). Eight participants declined to respond to this survey. Their response data from the other questionnaires were still used in the group analyses. Using a least mean square approach, there was a significant group difference between the AVI mean scores and corresponding categories of Self-Rated Voice Quality ($P < 0.0001$). Post hoc analyses using Tukey test and adjusted for multiple comparisons also found significant differences between AVI scores between “mild” and all other categories, except “mild to moderate.” Individuals with a self-rating score of “normal” demonstrated the lowest mean raw score on the AVI, whereas individuals with a self-perceived voice rating of “severe” had the highest mean raw score on the AVI. The mean score and standard error for each of the self-perceived rating categories is presented in Table 4. Figure 2

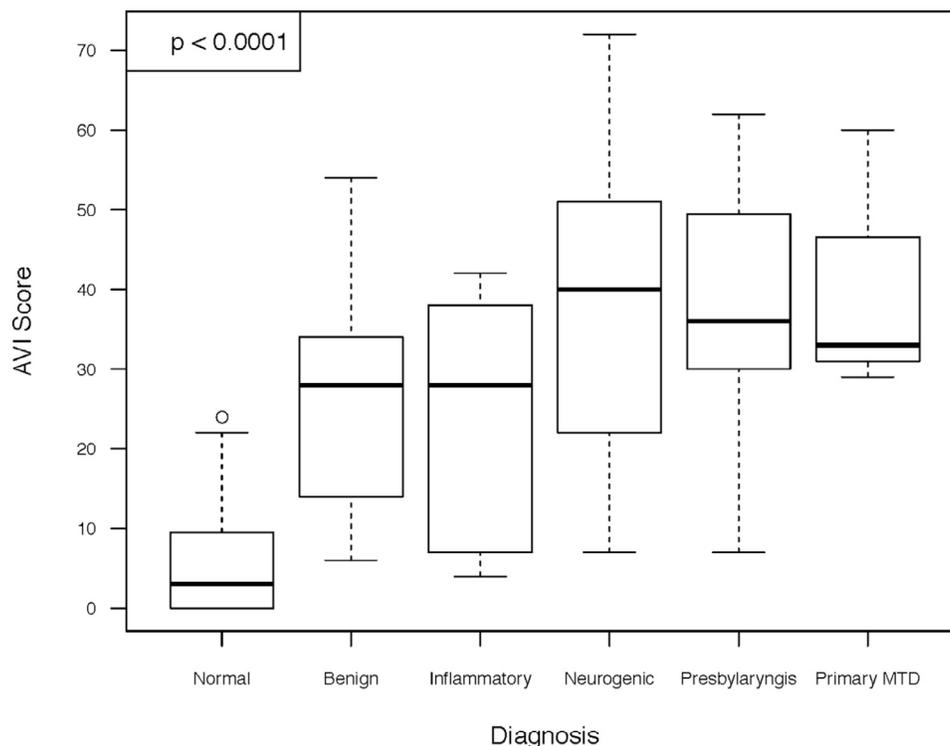


FIGURE 1. AVI mean score by diagnosis categories.

TABLE 4.
Corresponding Mean AVI Score by Self-rating Severity

Self-rated Voice Quality	Mean AVI Score (0–92)	Standard Error
Normal	6.286	2.513
Mild	24.889	2.714
Mild to moderate	33.889	3.838
Moderate	43.563	2.879
Moderate to severe	43.187	2.879
Severe	51.000	5.757

shows the distribution of AVI test 1 scores for each of the rating categories.

A Cronbach coefficient alpha was used to determine internal consistency or scale reliability for the AVI. The raw Cronbach alpha for the AVI was 0.949, indicating excellent internal consistency. Pearson correlations were used to determine how strongly associated the AVI was to retest and to VRQOL scores. AVI test 1 was significantly correlated to both AVI test 2 ($r=0.954$, $P<0.0001$) and the VRQOL score ($r=0.879$, $P<0.0001$). A second assessment of test-retest reliability was completed for the AVI test 1 and test 2; the intraclass correlation was 0.952. The AVI scores were not significantly correlated with age ($P=0.9395$).

DISCUSSION

Using one's voice to communicate is important for everyday life and is the basis for oral communication for many

older adults. Work by Smith and colleagues found older participants with voice disorders were more likely to show quality of life affects⁸ with perceived greater social, psychological, and communicative consequences in older adults than those of working age with a voice disorder. With the completion of the final stage of scale development for the AVI, researchers and clinicians have a valid and reliable means of assessing the impact of a voice disorder on quality of life in an older population using a scale that was specifically designed around their experiences.

The AVI was validated against a currently available quality of life index for individuals with voice disorders, the V-RQOL. The V-RQOL is an excellent tool for measuring quality of life impact of voice disorders; however, it was created and validated for a younger population with an average age for participants of 51.2 years for those with voice disorders and 49.9 years for those without voice disorders. The age range included in their study was from 19 to 85 years.¹³ To capture the impact of a voice disorder on such a wide age range of individuals, more general questions focusing on the domains of physical-functioning and social-emotional were used. In the AVI, themes and questions were developed from qualitative interviews completed in earlier stages of scale development.⁴ During semistructured interviews, patients discussed their voices in ways that crossed domains. Themes in the AVI include patients' desire for people to understand them when they speak, feelings of being held back or hindered by their voice disorder, increased effort to speak, disliking the way their voice sounds, emotional reactions to their voice, and an overall resilience to continuing to try to live and enjoy life regardless of their voice disorder.⁴ The inclusion of these multidimensional themes in the AVI may make

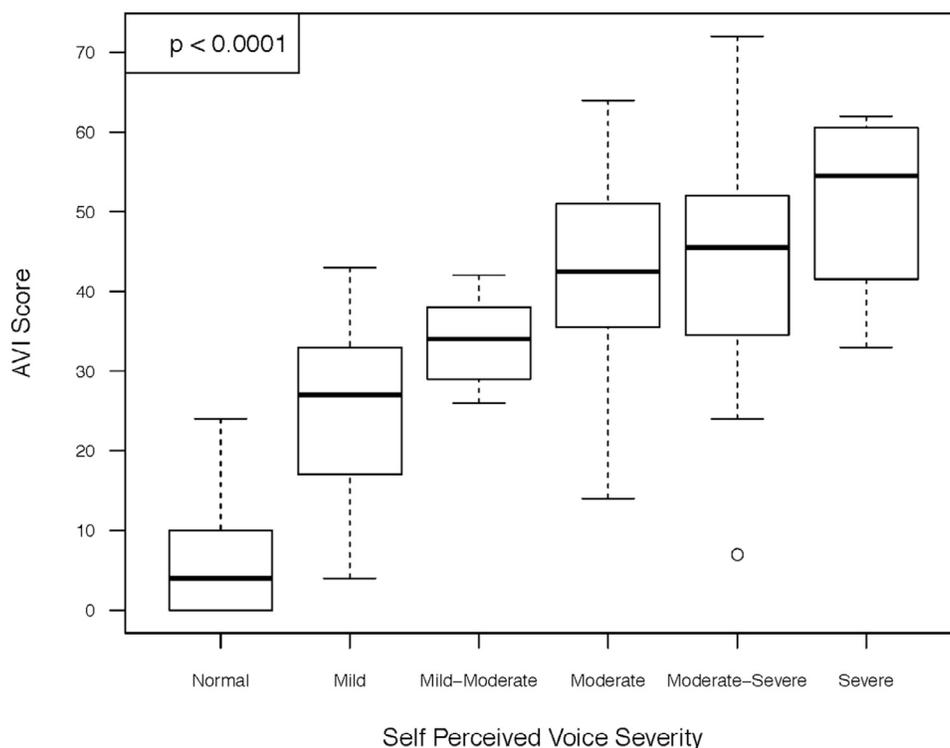


FIGURE 2. AVI score by self-perceived voice severity.

for a richer, more in depth survey of the impact a voice disorder has on the quality of life of older adults.

The AVI was found to be reliable within participants for the test-retest condition. Participants were asked to complete the AVI a second time in one of two ways: they were given a self-addressed envelope with the second AVI and asked to return it within a week of their appointment, or if they were at their first diagnostic session, they completed the AVI a second time after all other diagnostic testing (aerodynamic, acoustic, visual, and perceptual assessments), but before the discussion of their diagnosis. This was to avoid any influence the clinician's judgment may have had on the participant's interpretation of their voice. This method of waiting approximately 1 hour between the two administrations was found to be sufficient to prevent a learning effect.²⁶

Significant differences in AVI scores by sex were not identified. Although the AVI did not show a significant difference based on race, a more diverse sample should be completed in the future. Significant differences in AVI score were identified for self-rated voice severity. Participants with increased self-perceived severity (normal to severe) had an increased score on the AVI. Therefore, individuals with more severe voice disorders through self-rating showed an increased impact of their voice disorder on their quality of life.

Significant differences on mean AVI score were also noted between participants with "normal" voice and all diagnostic categories, except those diagnosed in the "inflammatory" category. This could be in part explained by the smaller number of participants in this diagnostic group. Future research could work to increase the number and variety of diagnostic categories. Similarly, a significant group difference on mean AVI score was identified between self-rated voice quality category of "mild" and all other categories, except "mild to moderate." It is possible there is not a large enough difference between self-perception of "mild" and self-perception of "mild to moderate" to be identified by the mean AVI score. As expected, individuals with "normal" voices had the lowest voice-related impact on their quality of life. Future studies with the AVI will be needed to determine clinically significant differences in AVI scores for pre- and posttreatment assessments for various voice diagnoses.

Conclusions

The AVI has been found to be a valid and reliable quality of life assessment for older adults with voice disorders. Use of the AVI in clinical assessments of voice disorders in older adults may provide further insight into the specific communication needs and dysphonia impact for this growing population.

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