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Degree of Vocal Handicap in Two Age Groups of Individuals

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DEGREE OF VOCAL HANDICAP IN TWO AGE GROUPS OF INDIVIDUALS

by

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ABSTRACT

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A healthy, functional voice is a critical aspect of daily life, allowing the expression of basic needs as well as interaction within an individual's community. Unfortunately, for many adults the voice declines in later life. The purpose of this study was to investigate how normal vocal aging affects the quality of life of the elderly. Two hundred two adults without voice disorders from two age groups (30-50 and 65-85) completed the Voice Handicap Index.[1] Results indicated that the older group felt a greater degree of vocal handicap than the younger age group [F (1,156) = 4.944, p = 0.028]. Implications of the study for care of the aging voice and areas for further research are discussed.

DEDICATION

I would like to dedicate this work to my husband, family, friends, committee members, and all of the community organizations that helped with the completion of this project. Without their support this project would not have been possible. I would especially like to dedicate this to my grandmother, Marie Thompson, without her support and guidance throughout the years I do not believe I would have had the strength or courage to complete this project.

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CHAPTER 1 – INTRODUCTION

Age-Related Vocal Decline

A healthy, functional voice is an important part of daily life, facilitating the expression of basic needs and allowing interaction within an individual's community. Consequently, limitations in voice production can negatively impact an individual's life along many fronts, including the social, emotional, functional, and physical domains.[2] The current literature available on the voice disordered population identifies a substantial negative impact of voice disorders on quality of life.[3, 4] For some individual's this impact may meet or exceed that of other chronic conditions, such as sciatica and sinusitis.[5]

For many adults, the voice declines in later life.[6-8] This decline is typically characterized by altered pitch (ie, increased in males, decreased in females), reduced loudness, hoarseness, breathiness, and vocal tremor.[7, 9, 10] Age-associated modifications of fundamental frequency, intensity, and noise-to-harmonics ratios support the aforementioned auditory-perceptual changes.[11] Finally, visual-perceptual indices of laryngeal function showing vocal fold bowing, vocal fold atrophy, and reduced glottal closure in older adults further support the auditory changes.[11-13]

Age-related anatomical and physiological changes of the respiratory, phonatory, and resonance systems are believed to underlie this vocal decline in later life.[6, 13-15] Multiple laryngeal changes are observed including: ossification of the laryngeal cartilages, deterioration of the sophisticated laryngeal joints, and modification of the vocal fold's epithelial, connective, and muscle tissue layers.[15-19] While these laryngeal changes are foundational to the vocal deterioration later in life, anatomical and physiological alterations in the respiratory and resonance systems likely magnify the laryngeal modifications.[15, 20-25]

Impact of Age-Related Vocal Decline

Studies of the voice disordered population identify a clear link between vocal abilities and quality of life.[3, 4, 26] Yet, to date, the impact of age-related vocal decline on daily life is unclear and minimally discussed in the literature. Consequently, the field remains unaware of the potential for age-related voice change to negatively impact individuals socially, emotionally, functionally, and/or physically.

Furthermore, previous work investigating the quality of life impact of voice disorders has shown that the negative consequences of voice concerns are perhaps magnified in the elderly population.[2] This finding suggests that voice may be more intricately linked with daily function and quality of life in the older population than in younger adults and highlights the importance of investigating the quality of life impact of age-related voice change.

Additionally, while gender differences in laryngeal and vocal aging have been well-documented,[6, 11, 27] potential differences in functional handicap across genders have not been investigated. Because the degree of vocal handicap experienced with age-associated vocal decline has not been considered in the field of speech-language pathology, the field remains unaware of the manner in which preventative and/or rehabilitative services might benefit this segment of the population and enhance their quality of life.

Current Study

The primary purpose of this pilot study was to determine if the population of older adults (65-85 years) experiences a greater degree of vocal handicap than the population of working age adults (30-50 years). A secondary purpose of this study was to determine if there was a gender difference in the degree of vocal handicap experienced later in life.

The descriptive study, performed in conjunction with the University of Kentucky, compared the vocal handicap of 2 age groups of adults. Two hundred and two adults with normal voices (ie, never sought treatment for a voice disorder) were recruited from the Huntington, West Virginia and Lexington, KY metro areas (100 adults ages 65-85 and 102 adults ages 30-50). Participants were divided evenly among the 4 cells under consideration: working age female, working age male, elderly female, and elderly male.

In order to participate in the study, individuals were required to fall within one of the two age groups under consideration in the study (30-50 years or 65-85 years). Furthermore, participants were required to meet the following inclusion criteria: (1) had never sought treatment for a voice disorder; (2) possessed sufficient English skills to read and comprehend questions of the Voice Handicap Index (VHI);[1] (3) lived independently or in an independent living facility; and (4) had no history of stroke or progressive neurological disorder. Individuals were excluded from the study if they: (1) had sought treatment for a voice disorder; (2) had English skills which did not support their reading or comprehending of the VHI; (3) lived in a residential facility where care was required at the "assisted living" or greater level; and/or (4) had a history of stroke or progressive neurological disorder. Individuals who met inclusion and exclusion criteria were given a brief screening of cognitive function (ie, the Mini-Cog[28]) to determine their capacity for responding to historical questions. Those passing the screening were included in the study.

For the study, participants completed a brief (ie, 5-10 minute), 2-part questionnaire. In part 1, individuals answered questions regarding their smoking history and personal medical history (ie, the presence or absence of 10 chronic medical conditions). The list of chronic conditions was selected from conditions commonly mentioned in the voice literature[27] and after

consultation with speech-language pathology, otolaryngology, and nursing. In part 2 of the questionnaire, participants completed the VHI,[1] a psychometrically strong, 30-item tool used to assess the impact of voice concerns on 3 domains of life: physical, functional, and emotional.[1] A 2 X 2 ANOVA examined for the main effect of age and the interaction of age and gender on vocal handicap.

Information from the study has the potential to offer valuable information regarding the degree of vocal handicap experienced by older adults and the impact of age-related dysphonia on daily function. Further, results may inform the field of speech-language pathology as to the need for programs to prevent and/or rehabilitate the aging of the voice.

This chapter has offered an introduction to the aging voice and has presented the rationale for this study. The following chapter reviews pertinent literature related to the study and includes an overview of voice production, a review of voice change in later life, consideration of the anatomical and physiological factors involved in vocal aging, a discussion of the quality of life concept, and a review of the relationship between voice production and quality of life.

CHAPTER 2 – REVIEW OF THE LITERATURE

Overview of Voice

Voice is an important aspect of everyday life, enabling individuals to express their basic wants and needs and communicate their deepest thoughts and feelings. Voice production is the result of a delicate interplay between the respiratory, phonatory, and resonance systems.[6, 13-15, 27] Briefly, exhaled air from the lungs flows upward to the adducted vocal folds. Subglottic air pressure gradually builds beneath the adducted folds, eventually blowing the membranous portion of the folds open. Tissue elasticity, combined with aerodynamic forces active between and above the vocal folds, draws the folds back to the closed position. Air pressure again builds below the folds, and the cycle of opening-closing repeats, creating the voice signal. Modifications in the signal are made as the sound travels through the supraglottal vocal tract.[29]

The slightest disruption of any one of these subsystems (ie, respiration, phonation, resonance) by either a functional or an organic process can alter the voice signal and trigger a compensatory reaction by the other systems. For many older adults, age-related changes in the larynx and vocal tract are of sufficient magnitude to bring about such alterations in voice production.

Vocal Aging

As with many other systems of the body, the voice production system develops and remodels throughout the lifespan, coming to maturity at approximately age 20, enjoying a period of relative stability from age 20-60, and beginning a progressive decline at approximately age 60.[29] For many older adults, the laryngeal changes occurring in later life are of sufficient magnitude to result in appreciable vocal decline.[6-8] Auditory-perceptual changes such as altered pitch (ie, increased in males, decreased in females), reduced loudness, hoarseness, breathiness, and vocal tremor[7, 9, 10] are commonly reported in the literature. Corresponding modifications in

the acoustic signal,[27, 30-34] the aerodynamic output,[33, 35, 36] and the vocal fold stroboscopic image[11, 13, 27, 37-39] are also reported. The study of these changes and their impact on individuals is of significant importance currently and in the next few decades as the field prepares to manage an elderly population twice the size of that in the United States today.[40] Toward that end, an overview of specific age-related changes in each of these domains of voice is provided below.

Auditory Perceptual Changes

Research has shown that individuals can accurately judge the age (ie, decade) of a speaker through auditory perceptual cues alone.[10] A number of studies have demonstrated the accuracy by which the older voice, in particular, can be identified.[9, 10, 41-43] In one early study, Ptaeck and Sander [10] found that ten listeners (speech pathology students) could successfully differentiate the voices of younger male and female adults (under the age of 35) and older male and female adults (over the age of 65) on the basis of a prolonged vowel production, a reading sample played backward, and a reading sample played forward. Key vocal features which prompted listeners to classify voices as "old" included: decreased rate of speech, less smooth speech pattern (ie, more hesitant in the production of speech, vocal tremor), increased hoarseness and strain, voice breaks, reduced pitch variability, and decreased intensity.[10]

In a similar study, Hartman[9] investigated the auditory perceptual characteristics associated with the aging male voice. Both trained and untrained listeners listened to recordings of male voices through the age of 50. Older voices were classified as such due to the presence of a reduced pitch, hoarseness, breathiness, decreased rate of speech, and lengthy pauses. Interestingly, trained and untrained listeners used the same perceptual set to classify the older voice,[9] a finding which spoke to the power of auditory perceptual cues to convey age-related information.

Hartman and Danhauer[44] asked trained and untrained listeners to identify the age group of 46 male voices after listening to a recorded tape. Both trained listeners and untrained listeners used the perceptual features of pitch, rate of speech, quality, and articulation to identify the age grouping of the male speakers. Specifically, older speakers were identified as having reduced pitch, hoarseness, breathiness, reduced speech rate, and imprecise articulation.[44]

Linville and Fisher[41] investigated the acoustic characteristics of women's voices as a function of perceived versus actual age. Seventy-five women who fell within 3 age groups (25 to 35, 45 to 55, and 70 to 80 years) were taped producing vowels in whispered and voiced conditions. One-second segments of the vowels were analyzed acoustically (fundamental frequency, fundamental frequency standard deviation, jitter ratio, F1, and F2) and then played over a loud speaker for 23 young listeners (20-28 years). Listeners categorized the voice segments as: young (25-35 years), middle-aged (45-55 years), and old (70-80 years). Results of a multiple regression analysis indicated that the identification of voices as "old" was associated with a reduction in fundamental frequency, an increase in fundamental frequency standard deviation, and a reduction in F1. The results demonstrated that both phonatory and resonance features play a role in the characterization of the aged voice.[41]

In a parallel study, Linville and Korabic[42] investigated elderly listeners' ability to estimate the age of women speakers (ages 25 to 35, 45 to 55, and 70 to 80 years) from phonated and whispered vowel productions. One-second segments of the vowels were played over a loud speaker for 23 elderly listeners (65-90 years) who were asked to judge the age of the speaker by categorizing by young (25-35 years), middle-aged (45-55 years), and old (70-80 years). Older speakers were identified with significantly great accuracy than were speakers in the younger age

groups. The findings suggested that indicators of vocal age may be particularly salient in elderly individuals.[42]

Thus, studies considering the auditory perceptual changes of voice in later life revealed alterations in the dimensions of pitch, loudness, and quality.[9, 44] Increased vocal tension, reduced speech rate, and vocal tremor have also been reported by some authors.[9, 10, 43-46] Interestingly, these voice changes were noticeable to trained as well as untrained listeners,[10, 43, 47] a fact which spoke to the magnitude of the age-related alterations.

Finally, while many of the early studies supporting age-related vocal decline focused on the male voice, it is important to note that shifts in the female voice have also been reported and that changes of the female voice differ from those observed in males. Older males evidence an upward shift in pitch, along with appreciable hoarseness and breathiness.[9, 10, 43-46] Females show a lowering of pitch accompanied by hoarseness; breathiness is not commonly observed in older women.[6, 10, 42, 48] Consequently, the study of vocal aging must be sensitive to gender differences and potential gender effects.

Impact of Changes

At least one study has shown that listeners associate older-sounding voices with negative personality characteristics.[47] In 1978, Ryan and Capadano[47] reported the results of two experiments designed to: (1) investigate the ability of listeners to accurately state a speaker's age based solely upon voice recordings and (2) study how listeners' perceptions of a speaker's personality related to their rating of his or her age. The studies found that not only did listeners effectively determine the age of a person by listening to the voice but that listeners developed perceptions of the speaker's personality based upon voice features alone. Older female speakers were characterized by listeners as "reserved," "passive," "out-of-it," and "inflexible," while older

male speakers were described as "inflexible." The results of this elegant study highlighted the negative reactions associated with vocal aging and brought to light the potential interpersonal and societal implications of age-related voice change.

Visual Perceptual Changes

Early information regarding visible changes in the vocal fold structure in later life was derived from the observation of post-mortem larynges. However, advancements in medical optics have opened the door to examining the vocal folds during voice production and to more fully appreciating changes in vocal fold anatomy and physiology across the lifespan. Laryngeal videostroboscopy, in particular, has revealed a number of changes in the laryngeal mechanism in advanced age.[11-13, 16, 27, 37, 38]

Visualization of aged larynges reveal characteristic changes in vocal fold appearance as well as function. As with the auditory perceptual domain, these changes vary across gender. In the discussion that follows, general visual-perceptual changes noted across genders are presented first. This is followed by a discussion of gender-specific alterations in vocal fold appearance.

General Changes

At the most superficial aspect of the vocal fold, both males and females evidence a grayish/yellowish discoloration of the vocal fold surface in later life.[11, 13] Honjo and Isshiki[11] and Mueller, Sweeney, and Baribeau[13] suggested that the discoloration of the vocal folds may be due to either fat degeneration or keratosis of the mucous membrane of the larynx. Furthermore, it has been documented that aging males and females experience a higher occurrence of vocal cord sulcus,[13] a groove in the surface of the membranous vocal fold, which usually extends along the fold's entire length and generally occurs bilaterally.[49]

Males

A number of studies have considered gross structural changes in the male vocal fold in later life. Patterns of change often described in the literature include: vocal fold bowing,[11, 13, 27, 39] prominence of the vocal processes,[13, 39] vocal cord sulcus,[13] and the presence of a spindle-shaped glottal gap.[11, 27, 39] Some researchers have attributed these changes along the vocal fold edge to atrophy of the laryngeal musculature, primarily to that of the thyroarytenoid muscle which rests at the core of the vocal fold proper.[10, 11] However, others have associated these features with the deterioration of the intermediate layer of the lamina propria which has been commonly observed in histologic sections of aged male vocal folds.[16] Thus, exact nature of these changes along the vocal fold edge in aged males is unknown.

Females

Visualization of female vocal folds has revealed a degree of change in later life; however, these changes have not been as well-defined as those of their male counterparts. The vocal folds of older women have frequently shown evidence of vocal fold edema.[11, 38] While the exact nature of the edema is uncertain, it has been suggested that the phenomenon may be secondary to endocrine changes at menopause.[11] Glottal gaps have also been identified in older women.[11, 27, 37, 38, 50] Curiously, gap configuration has not been as well defined in the female larynx as in the male, and explanations for the gaps in females remain limited.

Linville[37] compared the glottal gap configurations of young and elderly women. While both age groups demonstrated glottal gaps, the location of the gaps varied. Young women commonly presented with posterior gaps; anterior gaps were rarely observed. Conversely, older women presented with gaps of the anterior or mid-cord regions; spindle-shaped gaps were present in some.[37] The reason for the shift toward an anterior or mid-cord gap in older women

was unknown; however, the authors speculated that the anterior or mid-cord gap in the membranous glottis may be due to atrophy of the thyroarytenoid muscle or atrophy of the connective tissue layers.[37]

Summary of Visual-Perceptual Changes

Research suggests that there are observable changes that occur to the vocal folds as people age. Discoloration of the folds and an increased incidence of cord sulcus are reported in both males and females.[11, 13] In addition, men commonly experience vocal fold bowing,[11, 13, 27, 39] prominent vocal processes,[13, 39] cord sulcus,[13] and the presence of a spindle-shaped glottal gap.[11, 27, 39] Some relate these classic features with age-related deterioration of the thyroarytenoid muscle[11, 13] while others postulate that the changes are due to tissue changes to the intermediate layer of the lamina propria.[14] Women may evidence vocal fold edema[11, 38] and glottal gaps in the anterior or mid-cord region,[37] the origin of which has not been clearly identified.

Acoustic Changes

During voicing, tissues of the head and neck transfer mechanical energy into sound energy (ie, the speech signal). The acoustic signal emitted during speech can be captured, measured, and used to infer information about speech production.[51] Consequently, various aspects of voice production can be appreciated by the consideration of acoustic information. Fundamental frequency, sound pressure level, noise-to-harmonics ratio, jitter, and shimmer are measures frequently discussed in the literature.

Research clearly supports differences in the acoustic signal of old and young populations.[11, 13, 30-34] While males and females experience similar patterns of change in some acoustic measures, they evidence differential patterns of change in others. Patterns of change for

fundamental frequency, intensity, noise-to-harmonics ratio, jitter, and shimmer are presented in brief below.

The literature indicates that the fundamental frequency of vocal fold vibration increases in males with age and decreases in females with age.[11, 13, 30-34] As fundamental frequency is influenced by the mass of the vocal folds, atrophy of the thyroarytenoid muscle (decrease in mass seen in males) and edema of the vocal folds (increase in mass seen in women) are likely related to the differential changes in fundamental frequency.[11] Reduction in vocal intensity is observed in both males and females with age.[52, 53] Researchers have suggested that the reduction in intensity may be due to changes at the level of the larynx and/or the lungs.[12] As for the former, it has been suggested that glottal gaps of older adults may limit the ability to build the subglottal air pressure required for increasing intensity. In the case of the latter, some have indicated the changes in lung structure and function (eg, reductions in chest wall compliance, decrease in vital capacity) may contribute to intensity concerns.[12] Finally, the measures of noise-to-harmonics ratio, jitter, and shimmer reflect the acoustic component of voice quality. Research has shown an increase in the degree of noise relative to the degree of harmonics in the voices of elderly men and women,[30, 31] an addition which may be attributed to glottal closure concerns and/or issues of vibratory stability. Studies of jitter and shimmer in older adults have been inconclusive.[30, 31, 38, 50]

Thus, the literature supports modifications in fundamental frequency, intensity, and noise-to-harmonics ratio with advanced age. Certainly additional work remains to be done to more clearly define changes in other key acoustic indices (e.g. jitter, shimmer, pitch sigma, voice range profile).

Aerodynamic Changes

Aerodynamic measures can be used to consider both the gross and fine aspects of the exhaled airstream during voice production and can, therefore, offer vital information regarding the structure and function of the subglottic respiratory system, larynx, and supraglottic vocal tract during phonation. While aerodynamic studies have a great deal to offer the study of the aging voice, research regarding aerodynamic changes with age is limited.

Age-related changes in the lung structure (eg, calcification of costal cartilages, alteration of thorax and lung size, infiltration of respiratory skeletal muscle by connective tissue and fat) and mechanics (eg, decrease in chest wall compliance, decrease in lung elastic recoil) have been documented.[20] Associated changes in lung volumes (eg, decrease in vital capacity, increase in residual volume) have also been observed.[20, 21] As a result of the above changes, speech breathing in older adults is altered and is characterized by: a reduced number of syllables produced per breath, an increased amount of lung volume expended per syllable, and greater rib cage excursions.[21]

Additional studies of laryngeal aerodynamics across the lifespan have suggested that mean airflow rates are maintained through older adulthood.[33, 35, 50] Other studies considering the degree of resistance exerted against the airstream at the glottal level (laryngeal airway resistance) have identified a reduction,[33, 36] elevation,[35] or maintenance of resistance with age.[54] Authors have suggested that gender differences in vocal anatomy and airstream management may account for a degree of the variability in study findings.[33, 35]

Anatomical/Morphological Changes Underlying Vocal Aging

As individuals age, the larynx undergoes a number of morphologic changes. Changes are widespread and involve the laryngeal cartilages, joints, musculature, as well as the vocal fold

proper. The changes with the greatest impact on voice production and, consequently, those most often discussed in the aging voice literature are those involving the layers of the vocal fold proper: the epithelium, superficial, intermediate, and deep layers of the lamina propria, and the thyroarytenoid muscle. A brief overview of changes in each of the layers is offered below.

Epithelium

The vocal folds are covered by a thin layer of squamous cell epithelium.[55] The layer encases and shapes the underlying layers while also dynamically controlling fluid transport from the vocal fold surface to the underlying layers.[56, 57] While study of the aging epithelium is limited, some studies identify a yellow or grayish discoloration, an increase in thickness, and a possible reduction in cell density.[17, 19, 58]

Lamina Propria

The layers of the lamina propria offer a significant contribution to vocal fold vibration. The superficial layer, known for its loosely organized elastic fibers and gelatinous properties, is critical in the production of the mucosal wave during phonation. Consequently, disturbances of the layer's rheologic properties can have a marked impact on the vocal fold's ability to participate in the sophisticated vibratory movements essential for normal phonation. With age, the elastic fibers of the layer lose some of their elastic nature and evidence a degree of roughening along their edges.[59] Furthermore, the fibrous proteins become less organized in their distribution. This shift toward a more irregular layout of fibers further influences the layers' flexible nature.[60] Finally, edema of the superficial layer is reported in females,[59] a feature which may alter the vibratory properties of the layer and subsequently modify the voice signal.[11] The intermediate layer of the lamina propria, a more organized collection of elastin fibers, also contributes significantly to vocal fold vibration, serving as a transitional layer between the highly

flexible mucosal layers and the deeper muscular layers and a base upon which the mucosal layer oscillates.[29] In later life, the layer experiences a decrease in the density of its elastin fibers and a subsequent thinning. These changes are particularly marked in men, where the layer takes on a concave appearance.[16, 59] Finally, the deep layer of the lamina propria is usually recognized by its well-organized network collagenous fibers, which offer a mechanical transition from the more elastic superficial layers and the more rigid muscle layer. In later life, however, the collagen fibers become denser and more disorganized in their course. These changes result in a deep layer which is thicker and more rigid in later life.[16, 59]

Muscle

At the core of the vocal fold proper, the thyroarytenoid muscle provides adductory action as well as a platform upon which mucosal vibration can occur.[29] Morphologic as well as physiologic changes have been observed in this vital layer with age. Morphologically, the aged vocal fold muscle demonstrates a reduction in overall muscle mass,[11, 18, 58, 61] a loss of muscle fibers,[18, 62-64] and the infiltration of non-contractile connective tissues.[58, 62, 63, 65] Physiologic modifications, including reduced muscle force, speed, and endurance, have also been reported in an aged rat model.[66] While the exact mechanisms of the above changes have not been fully elucidated, a combination neurologic (ie, changes in the recurrent laryngeal nerve, modifications at the neuromuscular junction) metabolic (ie, reduced blood flow, mitochondrial changes), hormonal (ie, reduction in laryngeal hormone receptors), and activity-based forces are likely at play.[67]

Summary

Research demonstrates that changes are present in the layers of the lamina propria and in the vocal fold musculature with age. Corresponding changes in the respiratory system (eg, lungs)

and upper vocal tract are also reported in the literature. However, a review of changes occurring within those systems is beyond the scope of this review. The reader is referred to Linville[6] for an overview of changes in the remaining subsystems of voice.

Voice and Quality of Life

In recent years, the term quality of life has been introduced into the medical literature. Most generally, the term has beem used to consider how a particular disorder or condition affects an individual's day-to-day functioning and/or his or her satisfaction with life.[68, 69] Quality of life has typically encompassed the domain of physical symptomatology as well as the areas of work, social, and psychological functioning.[1, 70-72]

The term quality of life was first defined by the World Health Organization (WHO) in 1947. The WHO, described quality of life as a state of complete physical, mental, and social well-being and not merely the absence of disease and infirmity. Since being initially defined by the WHO, several definitions have emerged. In 1985, Ferrans and Powers[68] presented quality of life as an individual's perception of well-being in the dimensions of life identified as important to that individual. In 1994, Osoba[69] discussed quality of life as a multidimensional construct that encompassed an individual's perceptions of his or her physical, emotional, social, and cognitive functioning as well as any negative consequences produced by disease or the treatment of disease. Thus, the concept of quality of life has matured over the years and has become an important consideration in determining how medical professionals view patients and their overall health status.

Much has been learned about the relationship between the presence of a voice disorder and an individual's quality of life. However, to date, there is little information available on how vocal aging impacts quality of life. In the sections that follow, the impact of voice disorders on

quality of life is presented. This is followed by a discussion of voice and its relationship to quality of life in the aged population in particular.

Effects of Voice Disorders on Quality of Life

Voice is an important aspect of daily life, and research has clearly demonstrated that disorders of voice have a negative impact on an individual's quality of life.[2-5, 24, 73] Studies examining the link between voice and life quality have been increasingly prevalent in the literature in recent years. A review of key studies regarding quality of life in the voice disordered population is presented below.

Smith et al[2] evaluated the perceived quality of life of 174 adult patients of varying diagnoses (eg, vocal fold paralysis, nodules, tension, bowing, etc.) enrolled in voice clinics in the University of Iowa Department of Otolaryngology and the University of Utah Division of Otolaryngology-Head and Neck Surgery, and the perceived quality of life of 173 nonpatients who accompanied the patients seeking care. The study evaluated the impact of voice concerns on 5 domains: activities or work functioning, social functioning, psychological functioning, physical symptomatology, and communication. The patient group in the study showed a greater concern than the non-patient group in all domains examined. The authors concluded that a large proportion of persons with voice disorders report adverse effects on overall quality of life.

Krischke et al[26] studied the impact of functional and organic voice disorders on quality of life. The researchers evaluated 108 dysphonic patients at the Phoniatric Department at Erlangen University Hospital, Erlangen, Germany. A total of 40 women and 29 men with organic voice disorders and 24 women and 15 men with functional voice disorders participated in the study. The patients completed the SF-36[74] questionnaire, a measure comprised of eight subscales which consider physical functioning, role function-physical, bodily pain, general health, vitality, social

functioning, role function-emotional, and mental health. The patients' scores on the questionnaire were then compared to the normal controls in the SF-36[74] test handbook. Results showed that the dysphonic patients had significantly lower scores than the normal controls on the following subscales: physical functioning, role physical, bodily pain, vitality, social functioning, and role emotional. There was not a significant difference in the subscales of general health screening and mental health. The researchers found that there was no significant difference in quality of life between patients with functional disorders and those with organic disorders.[26] Results of the suggested a marked and broad impact of voice disorders on ratings of health quality.

Benninger et al[5] evaluated 163 patients with diagnoses including spasmodic dysphonia, vocal fold paralysis, other neurogenic voice disorders, benign vocal fold masses, functional disorders, vocal fold edema, leukoplakia, and cancer using the SF-36[74] and the VHI.[5] The authors found that patients with dysphonia reported low levels of physical, social, and mental functioning.[5] Interestingly, patients with dysphonia had a lower level of physical functioning than people with chronic sinusitis, lower levels of social functioning than those with angina and sciatica, and a lower mental health score those with angina. The authors concluded that dysphonia was a significant disability capable of impacting a person's life as much as other, more well-known, chronic conditions.[5]

Wilson et al[4] studied the impact of vocal dysphonia on general health using the SF-36,[74] an 8-section survey of health quality.[74] The authors found that patients with voice disorders had significantly poorer self-rated quality of life across all health status subscales measured by the SF-36.

Finally, Verdolini and Ramig[3] looked specifically at the relationship between voice disorders and their relationship to occupational handicap. The authors performed a review of the literature, specifically looking for cohesive information concerning the functional consequences of voice disorders and occupational risk factors.[3] The review showed that voice disorders negatively impacted individuals' ability to work and their overall quality of life.[3]

The above studies point to a clear relationship between voice disorders and quality of life. However, many of these studies have considered the working age population. Only a few studies have considered the impact of voice disorders on the elderly population. Those studies are reviewed below.

Voice Disorders and Quality of Life in the Elderly

A single study has considered the relationship between voice concerns and quality of life in the elderly population. Smith and colleagues[2] studied the perceived quality of life of 174 adult patients enrolled in voice clinics at the University of Iowa Department of Otolaryngology and the University of Utah Division of Otolaryngology-Head and Neck Surgery and the perceived quality of life of 173 nonpatients who accompanied the patients seeking care. The breakdown of participants by diagnosis was as follows: spasmodic sysphonia (30.5%), neuromotor conditions/vocal fold paralysis (19.0%), nodules (17.2%), laryngitis/edema (8.6%), musculoskeletal tension (5.7%), bowing (2.3%), laryngeal trauma (2.3%), vocal fold scarring (1.7%), contact ulcers (1.1%), and a small number of other conditions. Researchers found that the heaviest psychological toll from a voice disorder was on the elderly population. Common among elderly participants in the study were reports of having to repeat themselves due to not being understood; an inability to express their thoughts and feelings due to the voice disorder;

and difficulty being understood in a noisy environment.[2] Results of the study spoke to the functional and psychological effects of the voice disorder in this segment of the population.

Smith et al's study suggested a notable impact of voice disorders on the elderly. However, little research has been conducted to evaluate the potential impact of the age-related voice changes noted above and quality of life.

Vocal Aging and Quality of Life

Only 2 studies have considered the relationship between vocal aging and quality of life.[75, 76] In the first of these studies, Verdonck-de Leeuw and Mahieu conducted a 5-year longitudinal study on 11 healthy males ranging in age from 50 to 81 years. Expert raters identified significant deterioration of the acoustic signal and increased perceptual roughness in participants over time. Participant self-reports of increased vocal instability supported these acoustic and perceptual findings. Of greatest importance to the current discussion, however, was the study's finding that as men aged, they had a greater tendency to avoid social engagements due to their voice.[76] This study offered early evidence of a relationship between vocal aging and quality of life. However, the limited sample size and the exclusion of women limited the study's ability to speak to the aging population as a whole. Consequently, there remained a need for additional large-scale studies to examine the relationship between vocal aging and quality of life.

Finally, Morsomme and colleagues[75] recently presented a study where the voices of older patients were evaluated using 3 self-rating tools: the VHI,[1] the DS-16,[*77] and the SF-36.[74] Several interesting findings emerged. First, the authors found that the elderly were more attentive to physical aspects of voice concerns than to emotional or functional aspects. Additionally, the

[*]The DS-16 is the Type D Scale 16, a reliable and valid scale used in assessing type D personality features (ie, negative affinity, social inhibition).

group found that older women reported a greater vocal handicap than older males. Finally, the older group, as a whole, was often unaware of and/or inattentive to its vocal limitations.

The Research Question

Current literature clearly supports deterioration of the voice with age. Furthermore, research indicates that this deterioration may be more prominent in males. Previous work with the voice disordered population reveals that alterations of the voice can affect features of daily life as often described as quality of life. To further investigate the impact of naturally occurring voice changes on quality of life of elderly individuals, the following questions have been raised. (1) Does the population of elderly adults (65-85 years) experience a greater degree of vocal handicap than the population of working age adults (30-50 years) as measured by the VHI?[1] (2) Is there an interaction between age and gender in determining the degree of vocal handicap? The following hypotheses arise from the questions:

Null Hypothesis 1: There will be no difference in the degree of vocal handicap experienced by elderly adults and working age adults as measured by the VHI.[1]

Alternative Hypothesis 1: There will be a significantly greater degree of vocal handicap in the group of elderly adults as measured by the VHI.[1]

Null Hypothesis 2 (interaction): There will be no significant interaction between age and gender in determining degree of vocal handicap as measured by the VHI.[1]

Alternative Hypothesis 2 (interaction): There will be a significant interaction between age and gender in determining degree of vocal handicap as measured by the VHI.[1]

This chapter has reviewed the pertinent literature related to this study and has posed the questions of interest and hypotheses. The following chapter will present, in detail, the methods used to examine the research question.

CHAPTER 3 – METHODS

Participants

Defining the Target Populations

Two hundred two adults with normal voices living in West Virginia and Kentucky participated in the study. Participants fell into 1 of 2 age groups targeted in the study: 30-50 years (working age adults) and 65-85 years (older adults).

Age divisions were selected so as to best consider the vocal handicap of older adults against that of younger adults. The 65-85 year age range for older adults was selected for the following reasons: (1) the range would capture individuals during a period of life in which age-associated laryngeal and vocal changes have been documented;[29] (2) the range would include individuals post-retirement and would, therefore, identify age-related rather than work-related vocal concerns; and (3) the range would correspond with age ranges commonly used in aging research.[78-80] The 30-50 year age grouping for younger adults was selected to capture a group of adults who were past the age of vocal maturation,[29] yet well in advance of age-related vocal decline.[78-80] A 20-year age span for the younger group to parallel the 20-year span selected for the older adult age group.

Sample Selection and Recruitment

For the purpose of this pilot study, the researchers used convenience sampling. Participants were recruited from regions surrounding Marshall University (Huntington, WV) and the University of Kentucky (Lexington, KY). Participants in the Huntington region were recruited via participation at health fairs, visits to senior centers and civic group meetings, posting of flyers, and word-of-mouth communication. Participants in the Lexington region were

recruited by colleagues at the University of Kentucky via flyers, word-of-mouth communication, and participation at the 2008 University of Kentucky Aging and Dementia Fair.

Inclusion / Exclusion Criteria

In addition to the age group limits, participants had to meet the following inclusion criteria: (1) had never sought treatment for a voice disorder; (2) possessed sufficient English skills to read and comprehend the questions of the VHI; [1] (3) lived independently at home or in an independent living facility; and (4) no history of stroke or progressive neurological disorder. Individuals were excluded from the study if they: (1) had previously sought treatment for a voice disorder; (2) had insufficient English skills and were unable to read the VHI; (3) lived in a residential facility where care was required at the "assisted living" or greater level; and/or (4) had a history of stroke or progressive neurological disorder.

Individuals who met the basic criteria for participation in the study were screened for cognitive status using the MiniCog.[28] The MiniCog is a reliable and valid dementia screening tool that can be administered in a short amount of time (approximately 3 minutes) and can be used with individuals regardless of their linguistic and educational ability.[28] For the purpose of this study, the investigators followed the guidelines provided in the initial validation of the MiniCog[28] and required a score of 3 out of 5 on the screening to pass. Scores of less than 3 were considered evidence of cognitive decline. Therefore, individuals receiving a score of 3 or greater on the MiniCog were included in the study. Those scoring lower than 3 were excluded from participating.

Sample Size and Power Analysis

An initial power analysis was performed in conjunction with the Biostatistics Department of the University of Kentucky. Voice Handicap Index[1] scores for normal working age males and females were drawn from the literature.[81] As VHI scores for elderly adults without voice disorders were not present in the literature, estimates of VHI scores for this age group were determined by 2 speech-language pathologists with a combined 45 years of experience in the treatment of voice disorders. A common standard deviation of 8.5 was used. Analysis revealed that a sample size of 200 individuals would permit the detection of main effects and interaction (age X gender) effects in a 2-way ANOVA with >80% power. Hence, 200 adults with normal voices were recruited. Participants were divided among the 4 cells under consideration: working age female, working age male, elderly female, and elderly male. Nineteen participants were recruited from the University of Kentucky via flyers, word-of-mouth communication, and the 2008 University of Kentucky Aging and Dementia Fair. One hundred eighty-three participants were recruited from Marshall University through cooperation with area civic groups, senior centers, health fairs, word-of mouth-communication, and flyers.

Materials and Measures

Cognitive Screening – The Mini-Cog[28]

The Mini-Cog, a reliable and valid tool for the screening of cognitive status,[28] was used to rule out cognitive impairment in participants. Participants were required to score ≥ 3 in order to participate in the study, per the guidelines established in the initial validation of the instrument.[28] To administer the Mini-Cog, researchers presented 3 common words to the participant. The investigator then instructed the participant to draw the face of a clock and set the time to ten minutes after eleven (11:10). After completing the clock task, the investigator asked

the participant to repeat the 3 words given at the onset of the testing. The words used in this study (airplane, locker, and wagon) were selected as they had been used previously in published studies of voice and swallowing disorders in the elderly.[82, 83]

Scoring of the Mini-Cog followed the guidelines set forth in the initial validation article.[28] The participant earned one point for the correct construction of the face of the clock and an additional point for correctly setting the time to ten minutes after eleven (11:10). Finally, the participant earned one point for each word he or she correctly stated at the close of the screening. Thus, the test had a maximum of score of 5 and a minimum score of 0. Scoring was done by the examiner at the time of Mini-Cog administration.

Primary Instrument

Researchers developed a 2-part survey for data collection. Part 1 collected information regarding the participant's age, gender, history of chronic medical conditions, and smoking history. Part 2 of the survey included the 30-item VHI,[1] a validated tool for measuring vocal handicap. Details of the survey's construction are provided below.

Part I. Medical and Smoking History

Participants offered their age, gender, smoking status, and the presence/absence of select chronic conditions in Part 1 of the survey instrument. (See Appendix A). Ten general body systems commonly affected by chronic disease or injury were considered in this study: respiratory conditions, autoimmune disorders, chronic pain, heart/vascular disease, neurological disease, cancer, gastric conditions, depression/anxiety, endocrine disorders, and bladder conditions. Researchers developed the list of conditions after considering medical concerns commonly linked with voice disorders.[27] The list of conditions was reviewed, modified, and finalized after consultation with speech-language pathology, otolaryngology, and nursing. For

the purpose of this study, participants were asked to indicate any conditions which they were currently experiencing or had experienced during their lifetime.

Part II. The Voice Handicap Index (VHI)

The primary instrument used to assess vocal handicap in this study was the VHI. [1] Details of the instrument's construction, scoring, and psychometric properties are offered below.

Construction and Scoring of the VHI. The VHI, developed by Jacobson et al,[1] is one of the earliest self-rating instruments developed in the field of voice. The index consists of 30 items designed to assess a voice disorder's impact along 3 primary domains: physical, emotional, and functional. Ten items are included per domain. Each item represents a statement regarding the voice which the patient is to consider and rate on a 5-point Likert scale, where 0 indicates "never" and 4 indicates "all of the time." Subtotals for each of the subscales, therefore, can range from 0 to 40, while the Total VHI score may range from 0 to 120. Scores from 0-39 represent "mild" handicaps, while scores from 40-59 and those from 60-120 represent "moderate" and "severe" handicaps, respectively.[1]

Psychometric Properties of the VHI. The tool was normed on a population of adults with voice disorders[81] with a mean age of 49 years and a standard deviation of 18 years. The initial validation study showed the instrument to have strong internal consistency reliability and test-retest stability.[1] Specifically, test re-test reliability was strong for the functional domain (r = 0.86), physical domain (r = 0.86), emotional domain (r = 0.92), and total score (r = 0.92). Internal consistency was also determined to be high (r = 0.95). The instrument's validity was determined by comparing VHI scores to client's self ratings of perceived voice severity. A moderate relationship (r = 0.60) existed between the instrument score and the client's severity

rating. Finally, the initial study suggested that a critical difference score of 18 demonstrated clinical change in voice over time.

Reviews of the VHI. The VHI has been reviewed by multiple authors since its development. Rosen and Murry[84] examined the VHI with groups of singers and nonsingers with a variety of vocal pathologies. The authors found significant differences in VHI scores for singers and nonsingers, with singers having lower VHI total scores (less perceived handicap) than nonsingers. Furthermore, the researchers identified significant differences in VHI scores for the 3 primary diagnostic groups represented in the study (nodules, polyps, and cysts), suggesting that the tool may be sensitive to different patterns of handicap in different diagnoses.[84]

Franic, Bramlett, and Bothe[85] conducted a review of 4 frequently used voice quality of life measures and concluded that the VHI met acceptable standards with respect to item information, versatility, practicality, breadth, and validity. While the authors found that the VHI *total* score met standards for internal consistency and test-retest reliability, the individual domains did not meet the reviewers' established criterion for these properties. Finally, Franic and colleagues were unable to confirm the VHI's responsiveness to change properties, citing lack of adequate methodological information in the original validation article. The authors concluded that the VHI was adequately developed for clinical decision making with individual clients but may lack sufficient psychometric strength in some areas for use in group studies.[85]

Additional studies of the VHI conducted in recent years have also shown the VHI to be preferable to other instruments in item information, practicality, and reliability.[86, 87] In 2007, Webb et al[86] studied the reliability and validity of 3 self-report scales which included the Vocal Performance Questionnaire (VPQ), the Voice Symptom Scale (VoiSS), and the VHI. The study found that the VHI had the highest level of internal consistency and reliability ($r = 0.83$). It was

also found that the VHI had good concurrent and criterion validity. The authors concluded that the VHI was a reliable and valid instrument for measuring the patient-perceived quality of life impact of a voice disorder.[86]

Finally, in their recent review of voice quality of life instruments, Zraick and colleagues[87]commented that the VHI was a psychometrically sound instrument that was appropriate for use in both clinical and research settings. The authors pointed out that the VHI was a widely accepted tool in the field of speech-language pathology, as evidenced by its translation into several languages,[88-93] its modification for pediatric clients and partners of clients,[94, 95] and the creation of a shortened, 10-item, form.[81] Consequently, the VHI has become widely accepted by researchers in voice as a standard measure of vocal handicap.[96, 97]

VHI Scores Considered in the Study. The primary dependent variable under consideration in this study was Total VHI score (*VHI-Total*). After the analyses were conducted to answer the primary research questions, follow-up analyses were conducted to consider the main effects and/or interaction effects of age and gender on the VHI subscales. Therefore, scores on the Physical Subscale (*VHI-P*), Functional Subscale (*VHI-F*), and Emotional Subscale (*VHI-E*) were used as dependent variables in secondary analyses.

Procedures

Study Design

The project was a descriptive, pilot study which investigated the impact of normal vocal aging on quality of life. The factorial design compared the vocal handicaps of 2 age groups (working age adults between 30 and 50 years of age, older adults between 65 and 85 years of age) of adults across gender.

Data Collection and Management

Setting

Examiners administered the survey instrument face-to-face in a private setting. The questions were presented in written format; however, the investigator offered to read the survey to participants, if needed. Participants took, on average, 5 minutes to complete the pre-screening and 10 minutes to complete the survey instrument.

Confidentiality

After completion, survey forms were placed in an envelope or other container and preserved in a secure area away from the immediate testing site. Signed consent forms were placed in a separate envelope or container in the monitored area. All information provided in the study was anonymous, with the participant's name appearing only in signature format on the consent form. Coding techniques that would have permitted the linking of consent forms with the response forms were not used in this study. At the close of testing at a given site, completed forms were maintained in a secure container under the supervision of the primary investigator until their entry into an Excel (Microsoft, 2003) document and their eventual storage in a locked filing cabinet in the primary advisor's office.

Data Entry

During the data collection phase of the study, the primary investigator routinely entered survey responses into an Excel (Microsoft, 2003) spreadsheet. A binary system was used to enter gender, age group, and the presence/absence of each chronic condition. Smoking status was entered as: 0 (never smoked), 1 (currently smoke), and 2 (history of smoking, but not currently smoking). In those individuals with a positive history of smoking, the number of years of smoking was entered as a separate continuous variable. The VHI total score and 3 subscale

scores were also entered as continuous variables. Finally, responses to each item on the VHI were entered (0-4) to permit researchers the option of reviewing the data for specific trends. Items on the VHI that were missing a participant response were marked with a dash (-) and considered as missing data. (See the Data Analysis section below for a detailed discussion of missing data management.) At the close of the study, all data were transferred to SPSS 15.0 (Chicago, IL) for analysis.

Reliability of Data Entry

To check the reliability of the data entry an individual blind to the purpose of the study checked 10% of the survey forms for accuracy of the data entry into the Excel document. The total number of data points entered correctly was divided by the total number of data points to determine the percentage of accurately entered data.

Management of Missing Data

SPSS cells corresponding to VHI total score (*VHI-Total*), VHI-Physical subscale (*VHI-P*), VHI-Functional Subscale (*VHI-F*), VHI-Emotional Subscale (*VHI-E*), and VHI individual questions were reviewed for missing data points. Missing data were managed per Tabachnick and Fidell's recommendations for cleaning data in large data sets.[98] Per the authors, when small amounts of data are missing in a random fashion within a large data set, the method of replacing missing data is unlikely to influence final results. Consequently, mean substitution was chosen to estimate the missing values. The value of each missing point was calculated by taking the mean of the entered scores within the subscale in which the point was missing and substituting the mean score for the missing data point.

Data Cleaning

Dependent variables considered in the study (*VHI-Total, VHI-P, VHI-F, VHI-E*) were considered for outliers using box-and-whiskers plots produced by SPSS. Outliers were removed prior to analysis. In addition, variables were considered for normality via the visual inspection of histograms and the calculation of z-scores for skewness and kurtosis. Variables showing significant z-scores for skew and/or kurtosis were transformed using square root or log10 functions; the function providing the greatest degree of correction while eliminating significant skew and kurtosis was selected. The transformed variable replaced the original variable in the data analysis.

Statistical Treatment for Main Effects and Interactions

Results were analyzed with a 2 X 2 factorial ANOVA.[99] The factorial ANOVA is used to respond to research questions where two or more grouping variables, or factors, are considered for their impact on a single dependent variable.[99] In the case of this study, age and gender served as the factors (fixed), each with two levels. *VHI –Total* was the primary dependent variable under consideration. The main effect of each grouping variable (ie, age and gender) was determined as was the interaction between these factors. An alpha level of .05 was used. All calculations were performed using SPSS 15.0 (Chicago, IL). Significant interaction effects were further considered by plotting group means and visualizing the direction of the interaction.

This chapter has offered an overview of the study's methods and has included a discussion of the sample, measures used, data collection, and data analysis. Results of the study are shared in Chapter 4.

CHAPTER 4 – RESULTS

Sample

Two hundred two people were enrolled in the study via convenience sampling. The sample was composed of 50 working age males (30-50 years), 52 working age female (30-50 years), 50 older males (65-85 years), and 50 older females (65-85 years). Characteristics of the original sample are provided in Table 4.1.

Analysis

Data Management and Reliability of Data Entry

To determine the accuracy of the data entry, an individual blind to the purpose of the study reconsidered 10% of the survey forms for accuracy of the data entry into the Excel document. The blind examiner compared 960 pieces of data from 20 individual surveys to their corresponding cells in the Excel document. No errors were found in the points examined. Data entry was, therefore, deemed to be accurate.

Data Cleaning

Missing Data. The SPSS cells corresponding to the variables *VHI-Total*, *VHI-P, VHI-F, VHI-E*, and cells corresponding with each of the 30 VHI items were reviewed for missing data points. Six data points out of a total of 6060 data points (0.001%) were missing. Close inspection indicated that data points were missing at random, as no single question or type of question contained more than one missing data point. As the missing data composed less than 5% of the data points and as data points were missing in a completely random fashion within a large data set, missing data were not considered to be a serious problem and the choice of method to replace the missing data was unlikely to influence the results.[98] Therefore, the 6 missing points were replaced by the mean substitution method. The value of each missing data point was

calculated by taking the mean of the entered scores within the subscale in which the point was missing and substituting the mean score for the missing data point.

Primary Analysis

To respond to the primary research questions, the factors of age and gender were analyzed for their influence on the dependent variable, *VHI-Total*.

Distribution of the Dependent Variable VHI-Total

An initial manipulation check of the data for the sample of 202 participants revealed a marked bimodal distribution on the primary dependent variable *VHI-Total*, indicating that respondents fell into two distinct groups. One group ($n = 41$) had a mode of 0, indicating that all individuals in the group had responded with a 0 (ie, "never") response to all questions on the VHI. As Rosen et al[81] found that even normal subjects score above 0 on the VHI, the researchers concluded that the 41 cases in the 0-score group were not sensitive informers. Consequently, the researchers eliminated these 41 cases from analysis. Briefly, 22 working age adults (7 males, 15 females) and 19 older adults (8 males, 11 females) were removed.

The distribution of the dependent variable *VHI-Total* was reconsidered with the remaining group of 161 participants. Visual inspection of a box-and-whiskers plot identified 4 outliers. These cases were subsequently removed from analysis, leaving 157 cases for analysis. The variable's distribution was re-examined for this final sample. The analysis showed a positive skew ($z = +8.91$) and positive kurtosis ($z = +7.39$). To correct for these concerns, *VHI-Total* was transformed via the Log10 function. Transformation yielded a normally distributed variable (*logVHI-Total*) with an acceptable skew ($z = -1.567$) and kurtosis ($z = -0.340$). Consequently, *logVHI-Total* was used as the dependent variable in the final data analysis.

Thus, a final sample of 157 participants was used to consider the primary research questions under consideration. The final sample consisted of: 40 working age males, 37 working age females, 41 older males, and 39 older females. Summary statistics for the final sample are provided in Table 4.2.

Description of the Dependent Variable

Descriptive statistics for the dependent variable *logVHI-Total* are provided in Table 4.3. For ease of score interpretation and clinical interpretation, true means and standard deviations for *VHI-Total* prior to the transformation of the variable are offered in Table 4.4. In brief, mean *VHI-Total* was 10.25 (*SD* = 10.01) for the working age group and 12.89 (*SD* = 11.24) for the older group. When considered by gender, mean *VHI-Total* was 10.40 (*SD* = 10.32) for working age males and 10.11 (*SD* = 9.82) for older males. Means were 11.93 (*SD* = 12.38) for working age females and 13.90 (*SD* = 9.98) for older females.

Analysis of Variance

A 2 X 2 factorial ANOVA (age X gender) was performed on *logVHI-Total* using SPSS 15.0 (Chicago, IL). The results indicated a significant main effect of age [F (1,156) = 4.944, p = 0.028], with the older age group reporting a greater degree of vocal handicap than the working age group. (See Table 4.5). The main effect of gender and the interaction effect of age by gender were not significant.

Secondary Data Analysis

The VHI is composed of 3 subscales, each measuring a distinct domain of vocal handicap: physical, functional, and emotional. As a significant main effect of age was identified, the investigators raised the question of potential differences in handicap across the 3 domains of consideration by the VHI. Consequently, the investigators further examined the data for main

effects of age and gender and the interaction of age by gender along each of the subscales. Data management and analysis for this secondary analysis are detailed below. Analysis for each of the variables, *VHI-P*, *VHI-E*, and *VHI-F* was initiated from the sample of 161 participants believed to offer sensitive and reliable responses on the VHI.*

VHI-Physical

Data Cleaning. Box and whiskers plots revealed one outlier on the variable *VHI-P.* The outlier was subsequently removed, leaving 160 cases for analysis. See Table 4.6 for descriptive statistics of the sample used for *VHI-P* analysis. The variable's distribution for the remaining 160 cases showed a positive skew (z = +7.547) and positive kurtosis (z = +5.029). The distribution was corrected with a square root transformation. After transformation, skew (z = +1.75) and kurtosis (z = -1.919) were within an acceptable range. Therefore, the square root of the *VHI-P* (*sqrtVHI-P*) was used for analysis.

Data Analysis. A 2 X 2 factorial ANOVA was performed. The analysis revealed a significant interaction effect of age X gender [F (1, 159) = 5.007, p = .027]. While a significant main effect of age [F (1, 159) = 4.067, p = .045] was identified, the significant interaction effect overrode the interpretation of this main effect. There was no significant main effect of gender. Results are shown in full in Table 4.7.

Estimated marginal means were plotted to reveal the nature of the interaction. The plot showed that as women increased in age *VHI-P* also increased. In contrast, as men increased in age mean *VHI-P* decreased. (See Figure 4.1.). The interaction, therefore, indicated an increasing physical handicap associated with vocal aging in women and a decreasing physical handicap associated with vocal aging in men.

* Sample following the removal of 41 cases with Total VHI of 0. The 4 outlying cases on the variable *VHI-Total* were re-entered at this point in the analysis.

VHI Functional Subscale

Data Cleaning and Analysis. The variable *VHI-F* was considered for outliers and the normality of its distribution as described above for *VHI-P*. Four outliers were identified and subsequently removed, leaving a sample of 157 cases for analysis. A check of the variable's distribution showed acceptable levels of skew (z = +4.72) and kurtosis (z = 0.50) and an appropriate visual distribution on a histogram. Consequently, no transformations of the variable were required. A 2 X 2 factorial ANOVA was performed. There were no significant main effects and no significant interaction effect for *VHI-F*.

VHI Emotional Subscale

Data Cleaning and Analysis. The variable *VHI-E* was considered for outliers and the normality of its distribution as described above for *VHI-P*. Six outliers were identified and subsequently removed, leaving a sample of 155 cases for analysis. Skew (z = +9.45) and kurtosis (z = +6.20) levels were above the acceptable level. The square root transformation resulted in acceptable levels of skewness (z = 4.66) and kurtosis (z = -1.03). Thus, a 2 X 2 ANOVA was performed using the transformed variable *sqrtVHI-E*. There were no significant main effects and no significant interaction effect for *sqrtVHI-E*.

Table 4.1. Summary statistics for the original sample of 202 participants.

	Male	Female
Working Age Adult	M = 39.16 years	M = 39.65 years
	($\pm$ 5.66)	($\pm$ 6.22)
	n = 50	n = 52
Older Adult	M = 73.30 years	M = 76.78 years
	($\pm$ 6.80)	($\pm$ 5.06)
	n = 50	n = 50

Table 4.2. Summary statistics (age and number of participants) for the final sample ($N = 157$) used in the primary analysis of *VHI-Total*.

	Male	Female
Working Age Adult	$M = 39.28$ years	$M = 39.95$ years
	($\pm$ 5.49)	($\pm$ 6.07)
	$n = 40$	$n = 37$
Older Adult	$M = 74.00$ years	$M = 76.62$ years
	($\pm$ 6.99)	($\pm$ 5.12)
	$n = 41$	$n = 39$

Table 4.3. Descriptive statistics for *logVHI-Total* – the transformed variable used in considering the research question. Means and standard deviations provided for each of the four cells.

	Male	Female	Total
Young	$M = 0.8178$	$M = 0.8211$	$M = 0.8194$
	(± 0.44179)	(± 0.4772)	(± 0.43223)
	$n = 40$	$n = 37$	$n = 77$
Old	$M = 0.8755$	$M = 1.0497$	$M = 0.9604$
	(± 0.43404)	(± 0.28678)	(± 0.37765)
	$n = 41$	$n = 39$	$n = 80$
Total	$M = 0.8470$	$M = 0.9384$	
	(± 0.43611)	(± 0.41018)	
	$n = 81$	$n = 76$	

Table 4.4. Descriptive statistics for *VHI-Total*. True means (prior to transformation) are provided for ease of clinical interpretation.

	Male	Female	Total
Young	$M = 10.4$	$M = 10.12$	$M = 10.28$
	($\pm$ 10.32)	($\pm$ 9.82)	($\pm$ 10.01)
	$n = 40$	$n = 37$	$n = 77$
Old	$M = 11.93$	$M = 13.90$	$M = 12.89$
	($\pm$ 12.38)	($\pm$ 9.98)	($\pm$ 11.25)
	$n = 41$	$n = 39$	$n = 80$
Total	$M = 11.17$	$M = 12.05$	
	($\pm$ 11.36)	($\pm$ 10.02)	
	$n = 81$	$n = 76$	

Table 4.5. Results of a 2 X 2 ANOVA analyzing the effects of age and gender on *logVHI-Total*. Results show a significant main effect of age on *logVHI-Total*.

Source of Variation	Sum of Squares	*d.f.*	Mean Square	*F*	Sig. of *F*
Corrected Model	1.387 (b)	3	.462	2.864	.040
Intercept	124.464	1	124.464	766.041	.000
Main Effects					
Age	.803	1	.803	4.944	.028*
Gender	.309	1	.309	1.901	.170
Interaction					
Age/Gender	.286	1	.286	1.759	.187

*p < .05

Table 4.6. Summary statistics (age and group size) for the final sample used in considering the effects of age and gender on the physical subscale, *VHI-P*. The mean age, standard deviation of age, and age range for each of the four cells are provided.

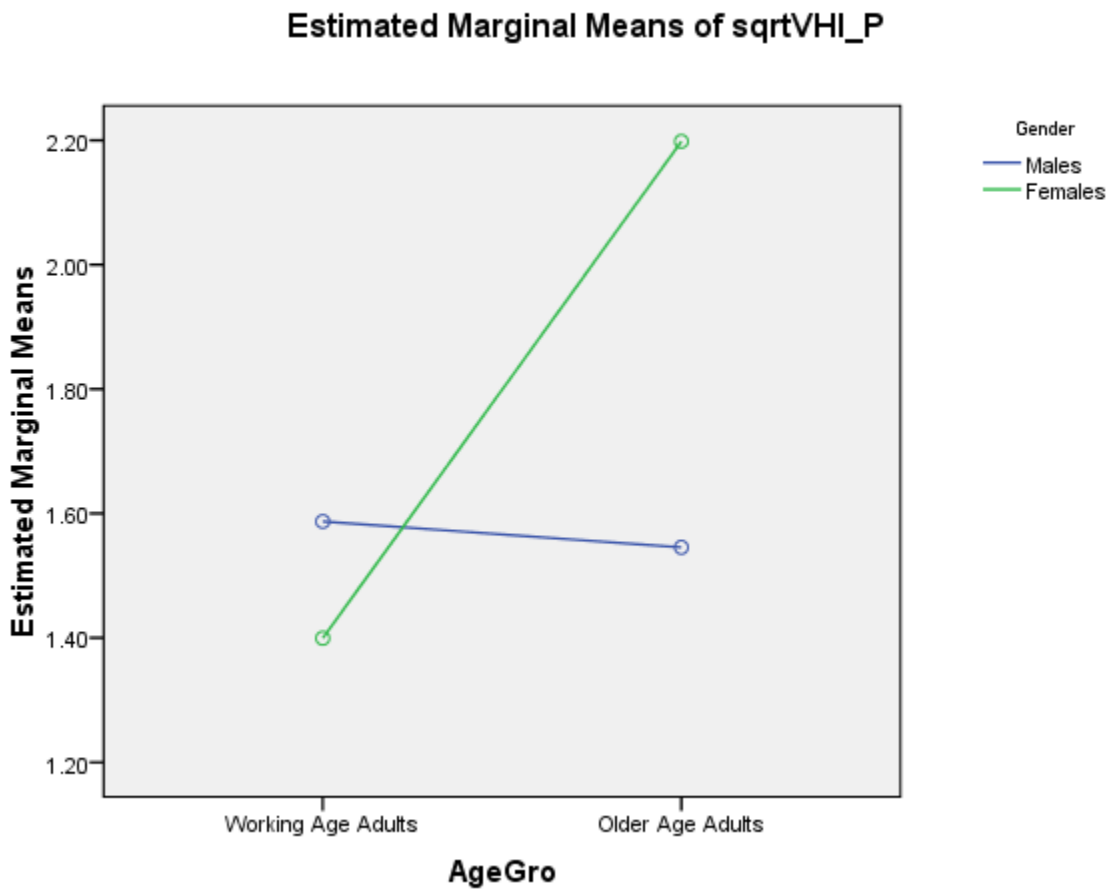
	Male	Female
Working Age Adult	M = 39.45 years	M = 39.95 years
	($\pm$ 5.63)	($\pm$ 6.07)
	n = 42	n = 37
Older Adult	M = 74.10 years	M = 76.62 years
	($\pm$ 6.93)	($\pm$ 5.12)
	n = 42	n = 39

Table 4.7. Results of a 2 X 2 ANOVA analyzing the effects of age and gender on the physical subscale, *VHI-P*. Results show a significant main effect of age and a significant interaction of age and gender. Interpretation of the significant interaction effect superseded interpretation of the significant main effect.

Source of Variation	Sum of Squares	*d.f.*	Mean Square	*F*	Sig. of *F*
Corrected Model	14.505 (b)	3	4.835	3.439	.018
Intercept	451.679	1	451.679	321.258	.000
Main Effects					
Age	5.717	1	5.717	4.067	.045*
Gender	2.156	1	2.156	1.533	.217
Interaction					
Age/Gender	7.040	1	7.040	5.007	.027*

*p < .05

Figure 4.1. Figure showing an increase in scores on the Physical Subscale with advancing age in women and a decrease on this variable in men.



CHAPTER 5 – DISCUSSION

The purpose of the study was to determine the effect of age-related vocal decline on voice-related quality of life. Investigators hypothesized that age-related voice changes would result in older adults evidencing a greater degree of vocal handicap than working age adults. Results of the study supported the hypothesis, showing a significant main effect of age on Total VHI scores. The findings indicate that natural vocal aging may place limitations on everyday life – findings that, for the first time, point to a practical daily impact of natural vocal aging.

A second purpose of the study was to determine if there was an interaction between age and gender on degree of vocal handicap. As the voice literature points to more prominent laryngeal and voice changes in males, the authors hypothesized that age and gender would interact, with older males showing more handicap in later life than older females. However, no interaction between age and gender was found on the Total VHI score. The results suggest that while laryngeal and vocal changes may be more prominent in males, the difference is not sufficient to cause a greater vocal handicap in that segment of the aged population.

This is one of the first studies to consider the impact of natural vocal aging on quality of life. Results do suggest a link between age-related vocal decline and daily function. However, it is important to note that while a statistically significant difference was found between older and younger groups on vocal handicap, the practical significance of a 2.63 point mean difference in Total VHI scores across age groups is unclear. Additional qualitative studies may offer insight into the real-life impact of natural vocal decline.

Physical Impact of Age-Related Voice Change

Because the VHI focuses on physical, emotional, and functional aspects of vocal handicap, the researchers questioned if additional main effects and/or interaction effects would

be found on individual subscales (ie, Physical, Functional, Emotional) of the VHI. With this in mind, the investigators completed a secondary analysis of the effects of age and gender on these scales. An interaction between age and gender was found on the Physical subscale, whereby self-reported physical aspects of the vocal handicap increased with age in women and decreased with age in men. Curiously, the interaction was in the opposite direction of what would be expected given the more marked laryngeal and vocal changes of older men and the less notable changes observed in women.[6]

The interaction effect noted on the Physical subscale has yet to be fully explained by the author. However, there may be several possible explanations for the seemingly paradoxical finding. First, the results may indicate a greater degree of sensitivity to vocal changes and/or a greater tendency to report concerns in females. Similar gender differences in self-reporting have been reported in the stroke literature.[100] Thus, the possibility of increased sensitivity and/or reporting in women must be entertained. In addition, it is possible that items on the Physical subscale relate more closely with the specific voice experiences of women. In a similar study of vocal handicap among teachers, Morsomme et al[101] found that women scored higher on the Physical subscale than men, suggesting that the questions on that portion of the VHI may be more sensitive to vocal experiences of women than those of men. However, a review of the questions on the Physical subscale by the author suggests that these items, in large part, focus on issues of vocal strain/effort, clarity, fatigue, and vocal inconsistency – issues not believed to be highly gender-specific in the older population. Consequently, the physical aspects of voice production in older females should be probed in more detail.

Finally, findings of increased handicap on the Physical subscale in women are indeed interesting in light of Roy et al's[83] epidemiological study of voice concerns in the elderly. The

group found that physical features of the voice (ie, vocal effort, feelings of discomfort) were reported more often by elderly persons with voice concerns than were perceptual voice complaints. These findings highlight the importance of using a holistic definition of voice concerns with the older segment of the population. Certainly, traditional perception-based definitions of voice concerns focused on deviations in pitch, loudness, and quality may ignore the more physically-based symptoms evident in this segment of the population and may not, therefore, accurately reflect the specific nature or impact of the dysphonia.

Implications and Future Directions

Treatment of Presbyphonia

The results of this study suggesting a negative quality of life impact of natural vocal aging point to the need for treatment programs to rehabilitate the aged voice. To date, however, little is known about the potential for behavioral and/or surgical treatment methods to enhance the voice of older adults. Voice texts have described basic behavioral protocols for vocal aging involving combinations of vocal hygiene education, respiratory retraining, vocal exercise, and relaxation.[102, 103] However, until recently, scientific study of the effectiveness of voice treatment on the aging voice has been notably absent from the literature. In the past year, however, two studies specifically aimed at this segment of the population have been presented.

Berg and colleagues[104] conducted a retrospective study of cases seen in a specialized voice clinic for remediation of age-related dysphonia. Patients had been treated with a combination of vocal hygiene, resonant voice therapy, and Vocal Function Exercises.[105] The results showed a significantly greater improvement in voice-related quality of life ratings in the group that had undergone therapy when compared to a group that had opted not to participate in

therapy. These results point to the potential for voice therapy to improve the daily vocal function of individuals with age-related dysphonia.

Gorman et al[106] examined a specific program of vocal rehabilitation (ie, Vocal Function Exercises[105]) for its impact on the voice of presbyphonic males. Nineteen elderly men performed the exercise program twice per day for a period of twelve weeks. At the conclusion of the therapy period, the group showed aerodynamic changes indicative of improved glottic closure (ie, significant reduction in glottal airflow, significant increase in subglottal pressure). The authors concluded that the vocal exercise program was effective in improving the vocal function of older men with presbyphonia.

Thus, early studies of behavioral treatment methods are promising, pointing to the potential for improving the phonatory abilities of older persons with age-related dysphonia. However, studies of additional treatment methods and of variability in responsiveness to treatment across genders are needed. Finally, randomized studies would be required to more definitively link therapies with improvement in voice.

As with behavioral methods, surgical intervention for presbyphonia has received little attention in the literature. Some have proposed the use of vocal fold augmentation and/or medialization in those affected by age-induced glottal incompetence.[107, 108] While early results are encouraging and point to improved voice and improved daily function after surgical intervention, to date, these studies have been focused on short-term outcomes only. Additional studies of the long-term effectiveness of surgical treatment for presbyphonia are needed.

Development of an Assessment Tool for the Elderly Population

In recent years, the field has produced a number of instruments for the rating of vocal handicap and voice-related quality of life.[1, 81, 109, 110] Some of these instruments are broad in

scope, designed for use with the majority of voice concerns.[1, 81, 110] Others are more focused, having been prepared for a specific diagnostic category or age-group.[95, 109, 111] The VHI used in this study would be classified as a general tool, appropriate for use across pathology and across multiple age ranges. Consequently, it is one of the most widely used voice quality of life indexes in the field. However, a review of the assessment items of the VHI indicated that several questions on the questionnaire were not applicable to the elderly population. For example, *"Does your voice disorder cause you to lose income?"*[1] Many of the aged individuals who participated in this study were retired and no longer depended on their voice to contribute to their income. Anecdotal reports of data collectors indicated that a number of participants felt this question did not pertain to their life situation. Similarly, participants raised concerns with the statement, *"My family has difficulty hearing me when I call them throughout the house."*[1] A number of individuals in the study stated that they lived alone and had no need to use their voice in such a manner. As a result, it became apparent to the investigators throughout the course of the study, that certain of the items were not relevant to the population considered in this study.

Similar concerns have been identified by Morsomme and colleagues.[75] The group compared the scores of older individuals on the VHI and other well-known general health-related quality of life tools. They found that a number of items on the Functional and Emotional subscales of the VHI were not adapted for the older population and their special social needs. What is more, the group identified 5 items which could be influenced by the hearing abilities of the patient themselves or to the hearing abilities of those in their immediate environment. Morsomme and colleagues argued that the increased incidence of hearing loss in the elderly may alter reporting on these items and make overall results on the VHI difficult to interpret in older patients.

The authors of the current study, therefore, propose the development of a self-report tool specifically geared to the elderly population. The tool should be carefully developed with the specific communicative needs and vocal concerns of the elderly population in mind. Literature on the age-induced perceptual and laryngeal changes would be helpful in designing items for such a tool, focusing items on particular vocal symptoms of the elderly (eg, difficulty projecting the voice). Additionally, recent work showing an increased awareness of the physical aspects of voice in the elderly indicate the need to consider these features as part of the tool.[83] Finally, in order to fully define the specific needs and concerns of the older population, researchers should work with the elderly to better define the limitations imposed by the voice. Once trends are identified, specific questions could be developed and the validation process initiated. This tool would be a notable contribution to the profession, offering a sensitive instrument to consider the vocal changes that occur in the elderly population.

Finally, Morsomme et al[75] found that many of the elderly persons with a vocal deviation did not report a vocal handicap in the VHI, a finding which the authors attributed to a lack of awareness of the voice problem. If such is the case, the lack of awareness may stem from an inability to perceive the subtle vocal changes of later life or from a relative inattention to voice given the associated medical concerns of this age group. Yet, work in other fields suggests that the limited reporting of handicap may not be due to a lack of awareness but rather to a general pattern of reduced reporting of complaints by the elderly population.[112] Whatever the cause of the disparity between actual vocal limitations and reported handicap in the elderly, it appears that it may be challenging to obtain an accurate representation of vocal handicap from patients alone. Recent work by Zraick et al[94] found that the partners of persons with voice disorders can serve as accurate raters of the degree of vocal handicap experienced by the voice disordered individual.

This would suggest that in older persons with voice concerns the use of a supplemental partner rating tool may be beneficial and may yield a more accurate representation of the concerns.

Defining Aspects of Vocal Aging

In the coming decades, the number of individuals in the United States over age 65 is expected to double.[40] In light of this fact, the field must direct resources toward better understanding the aging voice from multiple perspectives. While certain aspects of laryngeal and vocal aging have been well-defined for some time (ie, laryngeal changes, perceptual features, acoustic markers, etc), other basic questions concerning age-related voice change remain unanswered. For instance, the exact prevalence of voice concerns in older adults remains unclear. A study by Roy and colleagues in 2007 suggested that the prevalence of voice concerns may approach 30% in the population of individuals over age 65 – a figure which speaks to the potential magnitude of the problem.[83] And while the work of Roy et al initiated the search for risk and protective factors for vocal aging, these areas require further definition. By identifying such factors, the field would be better equipped to develop plans aimed at the prevention or moderation of age-related voice decline.

Certain risk and protective factors are difficult to examine and, as a result, have received little attention in the voice circles. However, these features remain important targets for study. For instance, voice use history is an important variable to consider. A study comparing individuals with a history of heavy voice use (eg, teachers) and those without such a history would lend vital information regarding the risk or protective nature of "use." Similarly, the protective nature or risk-inducing role of vocal "exercise" in later life could be examined. Studies comparing individuals who continue consistent and sophisticated use of the vocal mechanism in later life (such as through participation in church choirs) with those who evidence

limited voice use later in life (such as those living alone) would offer valuable information as to the role of voice use in later life.

Study Limitations

Sampling

A power analysis conducted prior to the study indicated that a sample of 200 individuals would be required. While a random sample of 100 working age and 100 older age adults would have been preferred, limitations in time and financial resources did not permit the collection of a purely random sample. Further, the study was developed to be pilot in nature. As this was the first large-scale study to consider the link between aging and vocal handicap, the researchers felt that a non-randomized form of sampling would be appropriate. As a result, the researchers used convenience sampling methods.

The use of convenience sampling would suggest that the sample used in this study may not be a proper representation of the population of working age and older age adults. As a result, findings of the study may not be readily generalizable to the population of older adults. Certainly, the results of this study showing a link between natural vocal decline and vocal handicap make the case for additional, larger-scale studies where the sample is randomly drawn from the population.

Use of the VHI

The VHI was developed to quantify the degree of vocal handicap experienced by persons with voice disorders and has been shown to be a reliable and valid instrument with that population. However, its use with normal populations has been limited, and a review of the instrument reveals that many questions do not apply to those without voice concerns (eg, *"I find that other people don't understand my voice problem."*[1]). The significant number of individuals

(n = 41) responding 0 ("never") to all 30 items on the index appears to further support this concern. Consequently, the tool may not be sensitive to concerns that are mild in nature, such as those experienced by the non-treatment seeking older adults that were the focus of this study. As a result, the results of this study may not accurately represent the impact of natural vocal aging on quality of life.

Self-report of Presence or History of a Voice Disorder

While differences across groups would suggest an increasing vocal handicap with age, the study cannot verify voice change as age-related rather than secondary to a primary voice disorder. For the purpose of this study, the presence and/or history of a voice disorder was defined by whether or not the individual had sought treatment for a voice concern. Those reportedly treatment-seeking were excluded from the study, whereas those who had not sought treatment were included. The researchers did not complete a perceptual rating of the voice on participants, and a laryngeal exam verifying the presence or absence of a disorder was not performed. Consequently, it is possible that the significantly higher VHI mean score for the older group may be reflective of a higher incidence of non age-related vocal pathology in that group and may not reflect a handicap associated with general, non-pathological, vocal aging.

Co-occurring Medical Conditions

While differences across groups would suggest an increasing vocal handicap with age, the study cannot verify voice change as age-related rather than secondary to co-occurring medical conditions or the use of vocally-harmful medications. A review of the data indicated a higher incidence of associated medical conditions in all probed categories (respiratory, autoimmune, chronic pain, cardiovascular, neurologic, cancer, gastrointestinal, endocrine, urinary) but one (anxiety/depression) for the older group. As conditions within many of these

categories and/or their associated medications have been linked with voice problems, it is important to consider that the increased vocal handicap of older adults may be secondary to medical concerns rather than laryngeal change and vocal aging per se. Certainly, teasing out medically-related and age-related issues remains an issue in much of aging research. In future studies on this particular topic, it will be important to document specific medical conditions and medications for each participant and to evaluate laryngeal structure and function. By doing so, researchers could better speak to the specific degree of vocal handicap experienced by those with classic age-related vocal decline.

Lack of Perceptual Voice Ratings

As noted above, researchers did not quantify or describe the voices of the individuals taking part in this study. As a result, vocal handicap cannot be considered against actual perceptual changes in the voice. Anecdotally, data collectors noted that a number of older individuals presenting with the classic features of presbyphonia reported that they had not noticed any voice change with age. This reduced self-awareness of vocal defects in older persons has been previously reported.[75] By quantifying the voice of each participant, researchers would be better able to link handicap with features of presbyphonia. A larger scale study with rating of key vocal features (eg, breathiness, reduced loudness, etc) should be completed.

Variability in Vocal Demands across Groups

It is important to consider that social and occupational differences may have existed between the two age groups examined in this study. Those in the older group likely had employment rates and social voice needs that were much lower than those in the working age group. As the VHI Functional and Emotional subscales contain questions which specifically speak to occupational and social voice use, it may be argued that the tool would more accurately

reflect the vocal condition of those in the working age range while, perhaps, under-representing the vocal handicap of those not employed or those without frequent social interaction. Thus, the groups' inherent differences in employment and social engagement may have created a situation where numeric differences were established between the two groups on the basis of tool design alone and in which the magnitude of handicap in older adults was not clearly reflected.

Conclusions

The results suggest that individuals over age 65 evidence a significantly greater vocal handicap than those of a working age and point to a potentially notable impact of presbyphonia on quality of life in older adults. This pilot study was the first to consider the daily impact of vocal decline in later life, and its findings point to the need to continue this line of study. Certainly, those involved in the care and treatment of the voice should be aware of the potential handicap associated with vocal aging and need to design and test treatment programs aimed at rehabilitating the presbyphonic individual. Additionally, the profession should consider preventative measures for their potential benefit to this segment of the population. Surely, the aging voice and its impact on the daily lives of older adults are areas ripe for study.

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Appendix 1
Data Collection Instrument: Cover Sheet and VHI

Age: _____

Gender (circle): Male Female

Check if you have any of the following conditions:

- ☐ respiratory condition (eg, asthma, allergies, emphysema, COPD)
- ☐ autoimmune disorder (eg, rheumatoid arthritis, lupus, etc)
- ☐ chronic pain
- ☐ heart disease / vascular disease (eg, high blood pressure, high cholesterol, etc)
- ☐ neurological disease or condition (eg, stroke, Parkinson's disease, etc)
- ☐ cancer
- ☐ gastrointestinal condition
- ☐ depression / anxiety
- ☐ endocrine disorder (eg, diabetes, thyroid problems)
- ☐ bladder condition

Smoking (Check the box that applies)

- ☐ I do not smoke and have never smoked.
- ☐ I currently smoke.
- ☐ I do not currently smoke but I have smoked in the past.

If you smoked in your lifetime, how many years did you smoke? _____

VOICE HANDICAP INDEX

These are statements that many people have used to describe their voices and the effects of their voices on their lives. Circle the response that indicates how frequently you have the same experience.

0 - never 1 - almost never 2 - sometimes 3 - almost always 4 - always

Part I-F

1) My voice makes it difficult for people to hear me 0 1 2 3 4
2) People have difficulty understanding me in a noisy room 0 1 2 3 4
3) My family has difficulty hearing me when I call them throughout the house 0 1 2 3 4
4) I use the phone less often than I would like to 0 1 2 3 4
5) I tend to avoid groups of people because of my voice 0 1 2 3 4
6) I speak with friends, neighbors, or relatives less often because of my voice 0 1 2 3 4
7) People ask me to repeat myself when speaking face-to-face 0 1 2 3 4
8) My voice difficulties restrict personal and social life 0 1 2 3 4
9) I feel left out of conversations because of my voice 0 1 2 3 4
10) My voice problem causes me to lose income 0 1 2 3 4

Part II-P

1) I run out of air when I talk 0 1 2 3 4
2) The sound of my voice varies throughout the day 0 1 2 3 4
3) People ask, "What's wrong with your voice?" 0 1 2 3 4
4) My voice sounds creaky and dry 0 1 2 3 4
5) I feel as though I have to strain to produce voice 0 1 2 3 4
6) The clarity of my voice is unpredictable 0 1 2 3 4
7) I try to change my voice to sound different 0 1 2 3 4
8) I use a great deal of effort to speak 0 1 2 3 4
9) My voice is worse in the evening 0 1 2 3 4
10) My voice "gives out" on me in the middle of speaking 0 1 2 3 4

Part III-E

1) I am tense when talking to others because of my voice 0 1 2 3 4
2) People seem irritated with my voice 0 1 2 3 4
3) I find other people don't understand my voice problem 0 1 2 3 4
4) My voice problem upsets me 0 1 2 3 4
5) I am less outgoing because of my voice problem 0 1 2 3 4
6) My voice makes me feel handicapped 0 1 2 3 4
7) I feel annoyed when people ask me to repeat 0 1 2 3 4
8) I feel embarrassed when people ask me to repeat 0 1 2 3 4
9) My voice makes me feel incompetent 0 1 2 3 4
10) I am ashamed of my voice problem 0 1 2 3 4

Thank you for your time and assistance with this study.

The Voice Handicap Index (VHI): Development and Validation
Barbara H. Jacobson, Alex Johnson, Cynthia Grywalski, Alice Silbergleit, Gary Jacobson, Michael S. Benninger

VHI Scoring

Subtotals

P = _____

E = _____

F = _____

VHI Total Score = _____

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EDUCATION

Marshall University, Huntington, WV

Bachelor of Science in Communication Disorders May 2007
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Marshall University, Huntington, WV

Masters of Science in Communication Disorders Anticipated graduation date May 2009

GRADUATE RESEARCH EXPERIENCE

- Master's Thesis
  Degree of Vocal Handicap in Two Age Groups of Individuals.
  Primary Mentor: Lisa B. Thomas, Ph.D.
- Founding member, Marshall University Department of Communication Disorders Community of Research Practice (MUCD CORP)
  Engaged in weekly research discussion group with faculty and students in Communication Disorders actively pursuing research agendas.
- Graduate Research Assistant to Lisa B. Thomas, Ph.D.
  Assisted in the development and execution of various research projects related to voice.

PRACTICUM EXPERIENCE

- Marshall University Speech & Hearing Center, Huntington, WV
  Supervisors: Heidi Boggs, M.S. CCC-SLP & Patricia Leonard, M.A. CCC-SLP. Gained clinical experience in the treatment and assessment of child speech and language disorders. Specific populations treated: Autism Spectrum Disorder, phonological

disorder, articulation disorder, and Specific Language Impairment. Experience offered unique opportunities in the areas of: group treatment and assessment of children with Autism Spectrum Disorder, minimal pair therapy, and development of home programs.

- Dunbar Primary School, Dunbar, WV
  Supervisor: Gennifer Curry-Taylor, M.A. CCC-SLP. Gained clinical experience in the treatment and assessment of child speech and language disorders within the academic setting. Specific populations treated: Autism Spectrum Disorder, phonological disorders, articulation disorders, and Specific Language Impairment. Experience offered unique opportunities in the areas of: Phase I and II of Picture Exchange Communication System (PECS), working with children who have global delays, cycles therapy, and minimal pair therapy.

- Kings Daughters Medical Center, Ashland, KY
  Supervisors: Cassandra Norris, M.S. CCC-SLP, Amber Wroblewski, M.S. CCC-SLP, and Alex Wallen, M.S. CCC-SLP. Gained clinical experience in the treatment and assessment of adult speech and language disorders within the hospital setting. Specific populations treated: aphasia, traumatic brain injury, dysphagia, dyspraxia, and hearing impairment. Experience offered unique opportunities in the areas of: bedside swallowing evaluation, modified barium swallow evaluation, thermal stimulation, cognitive therapy, language intervention, speech reading, and counseling.

- Milestones Physical Therapy, Teays Valley, WV
  Supervisor: Jennifer Hatfield Ball, M.S. CCC-SLP. Gained clinical experience in the prevention, treatment, and assessment of child speech and language disorders within the clinic setting and early intervention setting (West Virginia Birth to Three). Specific populations treated: Autism Spectrum Disorder, fluency disorders, cerebral palsy, tubular sclerosis, articulation disorders, Down's Syndrome, and expressive and receptive language disorders. Experience offered unique opportunities in the area of: Augmentative Alternative Communication devices (Vanguard, MightyMo, PECS, Flash Four, various switches), working within the natural environment of the child, and prevention with high-risk children.

PROFESSIONAL PRESENTATIONS

- Casey-Heatherman, W.N., Banks, C. & Thomas, L.B. Paper submitted for presentation at the American Speech-Language-

Hearing Association Annual Convention, New Orleans, LA. (under review).

- Banks, C., Casey-Heatherman, W.N., Clark, M., Ellis, K., Fraley, A., Gardner, G., et al. Paper submitted for presentation at the American Speech-Language-Hearing Association Annual Convention, New Orleans, LA. (under review).
- Casey-Heatherman, W.N., Banks, C., Thomas, L.B., & Stemple, J. (2009, April). *Degree of vocal handicap in two age groups of individuals.* Poster session presented at the West Virginia Speech-Language-Hearing Association Annual Convention.
- Thomas, L.B., Banks, C., Casey-Heatherman, W., Clark, M., Ellis, K., Frank, S.T., et al. (2009, April). Community of Research Practice: Fostering Scholarship Among Students and Faculty. Poster session presented at the West Virginia Speech-Language-Hearing Association Annual Convention.
- Casey-Heatherman, W.N., Thomas, L.B., & Stemple, J. (2008, November). *Degree of vocal handicap in two age groups of individuals.* Poster session presented at the American Speech Language and Hearing Association Annual Convention, Chicago, IL.
- Casey-Heatherman, W.N. (2008, October). *Degree of vocal handicap in two age groups of individuals*. Paper presented at the meeting of the Marshall University Community of Research Practices, Huntington, WV.

CONTINUED EDUCATION IN AREA OF INTEREST

American Speech Language and Hearing Association Annual Convention, 2007, 2008

West Virginia Speech-Language-Hearing Association Annual Convention, 2008, 2009

PROFESSIONAL SERVICE

Assistant Session Moderator, West Virginia Speech-Language-Hearing Association Annual Convention, 2009