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Demonstrable Effect of Vocal Changes on Singing Voices of Post-Menopausal Women

An Honors College Project Presented to
the Faculty of the Undergraduate
College of Health and Behavioral Sciences
James Madison University

by Haley Kemp Griffith

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Accepted by the faculty of the Department of Communication Sciences and Disorders, James Madison University, in partial fulfillment of the requirements for the Honors College.

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PUBLIC PRESENTATION

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Abstract

There is little research concerning the impacts of menopause on the female singing voice, and few research studies examine any treatment methods or exercises to help sustain vocal quality throughout and after menopause. To determine areas in which more detailed studies could be completed, I completed a thorough literature review of current research studies that investigate relationships between menopause and the voice. Many studies examined vocal symptoms of menopause, such as a lowered fundamental frequency (F0) and decreased vocal quality. However, there exists no formally researched or published vocal exercises that help to mitigate these menopausal voice symptoms.

In response, I created a research plan that addresses these topics. In the proposed study, selected postmenopausal participants would complete a six-week regimen of daily vocal exercises that target respiration, resonance, and phonation. Participants would visit a voice lab three times throughout the study, where their frequency range, intensity range, and harmonic/noise ratio would be measured using Computerized Speech Lab (CSL) software. Vocal changes would be tracked over time and analyzed by the principal investigator. A study such as this would hopefully improve the singing voices of the participants and provide postmenopausal women with a researched vocal exercise regimen that would allow them to retain their singing voices for as long as possible.

Introduction

In today's society, more women continue to sing recreationally much later in their lives. However, there remain many unknowns about the singing voice after menopause, and few studies have been completed on this topic. Since women now have longer life expectancies, there is a need for voice experts to study and work with postmenopausal symptoms more than ever before. Although women generally reach menopause between the ages of 45 and 55, premature menopause can begin before the age of 40 (www.womenshealth.gov, 2018). Because of decreased collagen and estrogen levels, menopause results in the drying out of certain body tissues, and the vocal folds are often impacted by these changes (Davis, 2004). During menopause, sex hormone receptors receive extra androgens, which thicken membranes of the vocal folds and lead to a deeper-sounding voice (Khare, 2016). Menopause can also lead to vocal fatigue in many women, causing difficulty for some professional female singers with the high extremes of their vocal ranges and with producing clear tone quality (Davis, 2004). The vocal cords and surrounding muscles are like any other part of the body; they must be cared for and kept in shape, especially as the body ages.

The physical changes that occur due to menopause have been heavily researched and include commonly known symptoms such as hot flashes, depression, insomnia, fatigue, and loss of concentration (Reid, 2019). However, due to a lack of clear understanding on how hormone fluctuations impact the vocal mechanisms, there is insufficient literature examining the impacts of menopause on the singing voice (Reid, 2019). Additionally, it can be easy to confuse symptoms of menopausal voice change with vocal aging, which occurs in both genders. Initial studies on vocal problems related to menopause only began in the 1990s, and few researchers have studied this area since then. Reported vocal complaints during menopause are prevalent in

17%-77% of women, and this wide range primarily results from the different definitions of vocal issues and the different research methodologies used (D'haeseleer et al., 2011). An examination of the literature on vocal changes related to menopause allows for a comprehensive review of current research studies and reveals areas in which more detailed studies should be conducted.

Literature Review

Prior to the late 20th century, there was little to no research concerning the vocal symptoms of menopause. In 1996, Boulet and Oddens conducted an initial investigation into voice changes around and after the menopausal period (Boulet & Oddens, 1996). The study targeted professional classical singers between the ages of 40 and 74, due to their increased awareness of the voice. Male singers were used as a control group. For the study, voice teachers and Ear, Nose, and Throat (ENT) consultants distributed questionnaires to participants in Belgium, the Netherlands, and Austria (Boulet & Oddens, 1996). Questions were designed to capture information related to positive and negative voice changes experienced within the year before the study, as well as any voice changes prior to that time (Boulet & Oddens, 1996). The results showed that although singers of both sexes reported vocal changes at around age 50, women more frequently described symptoms of huskiness, inability to reach high registers, reduced flexibility of vocal folds, and difficulty maintaining vocal control (Boulet & Oddens, 1996). The majority of women reporting vocal changes stated that they believed their symptoms to be a direct result of menopause (Boulet & Oddens, 1996).

A 2017 study compared the acoustic parameters and phonatory symptoms of menopausal women and pre-menopausal women, while considering body mass index (BMI) (Hamdan, Ziade, Tabet, Btaiche, Fakhri et al., 2017). Results indicated a higher prevalence of vocal symptoms, specifically throat clearing and dryness, in menopausal women compared to premenopausal women (Hamdan et al, 2017). There was no statistically significant difference in the acoustic parameters. However, this study compared women who had not yet reached menopause to women who were experiencing menopause; it did not consider post-menopausal women. The study showed no correlation between BMI and vocal symptoms. (Hamdan et al., 2017).

In 2004, Schneider conducted a study attempting to determine the prevalence of menopausal voice impairment and to define these voice alterations (Schneider, 2004). Almost half (46%) of participants reported changes of the voice post-menopause, and most participants reported vocal symptoms including dryness, roughness, lower average pitch of speaking and singing voice, and frequent throat clearing. Within the group experiencing post-menopause vocal discomforts, the majority of participants demonstrated mild swelling of the vocal folds, edema of the free edges of the vocal folds, and/or typical edema in the subepithelial Reinke's space. Additionally, these women were found to be significantly less likely to reach at least 15 semitones with their singing voice (Schneider, 2004).

A 2011 study conducted in Belgium aimed to measure the impacts of menopause on vocal characteristics by comparing premenopausal and postmenopausal women (D'haeseleer et al., 2011). In this study, 38 postmenopausal women averaging 58 years old were examined as the participant group, and 34 premenopausal women averaging 45 years old were used as a control group. All participants had no history of breast cancer, displayed normal hearing, and were nonsmokers. The study also excluded professional singers and women who had taken any vocal training. The researchers used both objective and subjective assessment techniques to determine vocal quality and function, and psychosocial impacts were measured through the Voice Handicap Index (VHI), a self-administered questionnaire that requires participants to respond on a scale of 0-4 about various statements regarding their experiences with vocal problems (D'haeseleer et al., 2011).

Results from this study showed that postmenopausal women showed a relatively good overall quality of voice and that vocal changes related to menopause do not significantly impact quality of life. However, objective differences in vocal characteristics between the two groups

were found in aerodynamic parameters, vocal range, and acoustic parameters (D'haeseller et al., 2011). Many previous studies show evidence of a clear change in fundamental frequency (F0) during menopause, but, interestingly, it is often difficult to determine whether F0 changes are caused by changing hormone levels associated with menopause or vocal aging (D'haeseleer et al., 2011). To attempt to clarify this, D'haeseleer's study analyzed both isolated vowels and speech while reading. The analysis of the acoustical properties of the isolated /a/ vowel revealed little difference in F0 between the two groups. When studied vocal properties while reading, however, a lower F0 was observed in the group of postmenopausal women. Continuous speech exhibited during reading is more similar to natural speech than an isolated vowel, so this study confirms that fundamental frequency changes are a true vocal symptom of menopause (D'haeseleer et al., 2011). Additionally, the investigators subjectively observed significantly more strained vocal quality and roughness in the postmenopausal group.

In 2012, D'haeseleer conducted another study concerning the impact of menopause and hormone therapy (HT) on the voice and nasal resonance. To investigate this, a cross-sectional non-randomized study design was used to compare vocal qualities and nasal resonance in both premenopausal and postmenopausal women (D'haeseleer et al., 2012). To attempt to exclude the impact of vocal aging, results were analyzed controlling for age (D'haeseleer et al., 2012). Study results showed that nasal resonance scores were constant between premenopausal and postmenopausal women. However, postmenopausal women (without HT) were found to have speaking fundamental frequencies (SFF) averaging 14 Hz lower than premenopausal women – a difference easily detectable for most listeners (D'haeseleer et al., 2012).

Hormone therapy is commonly used to help treat and control the physical symptoms of menopause. Another objective of this study also aimed to discover if hormone therapy could be

used to counteract menopausal vocal changes (D'haeseleer et al., 2012). Postmenopausal women without hormone therapy displayed a lower SFF and were able to phonate lower in pitch compared to postmenopausal women with hormone therapy, showing that hormone therapy can counteract SFF decrease (D'haeseleer et al., 2012). Additionally, this study questioned whether the type of hormone therapy plays a role in vocal characteristics. No objective or subjective differences in vocal characteristics were found between estrogen therapy and estrogen and progesterone therapy, but the researchers noted that further study is needed to determine if the hormone therapy type, concentration, or way of administration plays a key role in vocal changes (D'haeseleer et al., 2012).

Research has also been completed specifically on the aging singing voice and on ways to encourage older singers to continue enjoying music throughout their lives. Estrogen therapy has been shown to be particularly helpful in delaying typical voice changes in menopausal female singers (Butler, Lind, & Weelden, 2013). A lack of sufficient estrogen levels can cause changes in mucous membranes that line the vocal tract, resulting in swollen vocal cords, enlarged blood vessels, and increased vocal fold mass (Butler, Lind, & Weelden, 2013). Additionally, hormone changes can lead to decreased fundamental frequency, hoarseness, loss of control when singing, and decreased vocal range (Butler, Lind, & Weelden, 2013). Voice therapy can help to maintain proper vocal technique and functioning, but permanent changes can occur and can significantly impact future singing ability. Vocal training can also serve to prevent or delay changes as a result of aging, and research has shown that professional voice users experience fewer vocal changes over time than amateur singers (Boone, 1997). It is recommended that professional female singers seek out hormone replacement at menopause to help maintain vocal quality and control (Boone, 1997).

Some voice teachers and singing experts are also exploring this topic. David Jones, a New York City voice teacher and coach with a 30-year teaching career, has, through his experience and research, learned a great deal about menopausal symptoms and their direct impacts to the singing voice. Such symptoms include reduced vocal flexibility and increased dryness, a weak high register due to difficulties in the upper passaggio, a more pronounced break between chest and lower head voice, pushed tone qualities, a lifted larynx, and a rigidity in vocal tone (Jones, 2004). Jones also found that singers experiencing menopausal changes can become depressed and overwhelmed, sometimes needing additional support and tools to help recover from and deal with voice changes (Jones, 2004).

Jones has conducted several case studies that more thoroughly describe some of these issues in action. A 57-year-old coloratura soprano had difficulty maintaining her vocal color as she ascended into her upper passaggio and range (Jones, 2004). Tension was evident at the back of her tongue, and she reported difficulty singing high notes that she had previously reached with ease (Jones, 2004). Through use of exercises to manage breath pressure and encourage tongue flexibility, the singer was able to regain her high register up to a C#6-D6, and she continued to perform regularly (Jones, 2004). Another student, a 72-year-old mezzo-soprano with a career as a music teacher, displayed few post-menopausal symptoms because she had continued to sing and vocalize throughout menopause and had actively focused on exercises to control breath pressure throughout that time (Jones, 2004). Without proper exercise, the muscles of the larynx can atrophy, so it is essential for singers to continue vocalizing consistently and to pay particular attention to their breath pressure and tongue flexibility throughout menopause (Jones, 2004).

Many voice professionals and singing teachers have come up with their own vocal training and warm-up programs to help keep the postmenopausal voice healthy. Although these

exercises have not been formally researched or published, they are often supported by years of personal experience and observation. Lynn Swanson, a renowned conductor, choral pedagogue, and musician, recommends a daily and systematic “vocal fitness program” to maintain healthy technique throughout and after menopause (Swanson, 2018). She advises singers to begin by warming up the muscles in the face, neck, shoulders, upper chest, and abdomen that are related to the vocal mechanism and to maintain an upright and balanced posture (Swanson, 2018). Her exercises are structured to help improve breath (inhalation and exhalation), relaxation of the vocal tract, flexibility of resonators and articulators, and overall vocal flexibility (Swanson, 2018). The exercises are simple and easy to complete, including hissing patterns, humming, lip trills, sirens, and quick scalar passages. Swanson also identifies several vocal problems that are common in postmenopausal singers, such as vibrato issues, a thin tone, and a creaky voice, and identifies specific exercises to target each fault (Swanson, 2018). For problems with vibrato, she recommends that singers examine posture and confirm that the jaw and tongue are relaxed. To help with a thin tone, she advises singers to sustain vowels on a single pitch and ensure that the correct amount of air is used (Swanson, 2018). A creaky singing voice is due to a consistently low speaking voice, so singers should become aware of their pitch and consciously focus on raising their speaking frequencies (Swanson, 2018). Additionally, Swanson advocates for lifetime maintenance of the body and vocal mechanisms, advising singers to focus on hydration, nutrition, physical exercises, and mental agility exercises (Swanson, 2018).

Future Studies

Although some current research has been done on the relationship between menopause and singing, there are no studies that examine the role and efficacy of daily, purposeful vocal exercises on the vocal quality of post-menopausal, recreational singers. Additionally, there are no formally published vocal exercises specifically recommended for targeting vocal function in postmenopausal women. After analysis of current literature, a study has been developed and planned for future research. The purpose of this study would be to determine if six weeks of daily respiratory, resonance, and phonatory exercises would improve acoustic and self-evaluative voice parameters in post-menopausal women. If women could complete an easy, brief succession of daily vocal activities to help maintain an active singing voice, they could continue to sing more easily into later life and possibly improve their overall quality of life.

Question 1: Would a six-week regimen of daily respiratory, resonance, and phonatory exercises improve acoustic features of participants' voices, as measured by frequency range, intensity range, and harmonic/noise ratio?

Question 2: Would a six-week regimen of daily respiratory, resonance, and phonatory exercises improve the participants' perception of their voice quality and abilities as measured by the Singing Voice Handicap Index (S-VHI)?

For this pilot study, a principal investigator (PI) would recruit five participants between the ages of 45 and 63 who self-identified that they had completed menopause within the last three years. Parameters include that the participants would not have had any formal classical voice training, but they would be recreational singers interested in improving their singing voice for activities such as singing in local or church choirs or participating in community theatre. Participants would be excluded if they had any past hormone therapy treatment or past issues

with their vocal cords, including reflux laryngitis within the past year or any history of vocal nodules, vocal cord paralysis, head or neck cancer, or vocal cord tumors. Participants would also be excluded if they had ever been smokers or if they had used hard drugs such as heroin, cocaine, methamphetamine, or oxycodone. This study would use a collective case design and no control group.

In an effort to improve different aspects of the singing voice, participants would complete four vocal exercises twice a day. The PI designed the exercises based on personal knowledge after seven years of classical vocal training and extensive research into past menopausal studies. Each participant would receive an exercise log to complete twice each day, documenting completed exercises, approximate amount of sleep the previous night, and approximate amount of water consumed that day. The exercises would fall into three categories: respiratory, resonance, and phonatory.

1. Respiratory exercise 1: Each participant makes four short /s/ sounds in a row and then blows out a /s/ for as long as they can before running out of air. This pattern is repeated twice. The goal of this exercise is to build up the muscles of the diaphragm to increase phonation time.
2. Respiratory exercise 2: Each participant takes two breaths in on a /pju/, being sure to engage the diaphragm on each stroke, before releasing the air on a breath out. This pattern is repeated four times. The goal of this exercise is also to strengthen the diaphragm and to coordinate the movement of the diaphragm muscles with the laryngeal/articulatory musculature.
3. Resonance exercise: Each participant performs a lip trill siren, which requires her to buzz the lips on a note in the middle of her range, then gradually up to her highest note, and

then gradually down to her lowest note, then back to the middle. This pattern is completed twice. The goal of this exercise is to gradually stretch the participant's range and increase agility of the laryngeal/articulatory musculature.

4. Phonatory exercise: Each participant sings the vowel /a/ beginning at a note in the middle of her range, then gradually up to her highest note, and then gradually down to her lowest note, then back to the middle. This pattern is completed twice. The goal of this exercise is to improve tone quality over the entire range and to further stretch the range.

The PI would demonstrate all four exercises for the participants on their first visits and review all exercises at each subsequent visit. On the first visit, each participant would be required to complete the exercises correctly with the PI three times consecutively to confirm mastery. The PI would provide exercise demonstration videos in either an mp4, online, or DVD format, based on each participant's personal preference.

Participants would be in the study for six weeks and visit a voice lab three times: on their first day, at approximately three weeks after beginning, and at the end of the six weeks. At all visits, the PI would record voice samples for analysis of participants' frequency range, intensity range, and harmonic/noise ratio and to document vocal change over time. The PI would use Computerized Speech Lab (CSL) software to acquire these samples and perform all tests in a quiet room with the participant placed 10 cm away from the microphone. To test frequency range, each participant would begin at the lowest note she can hit and gradually sing an /a/ up to the highest note she could hit in one breath. To test intensity range, each participant would choose a note in the middle of her range and begins at the quietest volume she can phonate, gradually increasing to her loudest volume in one breath. To test harmonic/noise ratio, each participant would simply sing a sustained /a/ vowel on a constant pitch. The PI would record the

note each participant used for intensity and harmonic/noise ratio, and the participant is instructed to approximate that note during all repeated recordings. All recording samples would be repeated three times each visit, and results are averaged for each visit. All audio data would be saved as .wav files on a secure server that requires granted access and is password protected. Saved audio samples would be de-identified by naming them only with participant identification number.

Data from each sample (frequency, intensity, or harmonic/noise ratio) would be taken from the first voice pulse and end with the final voice pulse for each relevant audio clip. The PI would average results for each measure at each participant visit and compile data in a Microsoft Excel document, where participants would be labeled by study identification number only. Participants would remain anonymous during all aspects of the study.

The PI would modify the S-VHI to 23 questions pertaining to vocal function and voice-related quality of life (Cohen, Jacobson, Garrett, Noordzij, Stewart, et al., 2007). Participants would complete the S-VHI during each of their three visits (baseline, week 3, and week 6). Participant S-VHI answers would be documented on a hard paper copy, where participants are again identified only by participant identification number. The PI would sum scores and save the information in an Excel document in a de-identified manner. A Friedman test would be used to statistically analyze the final accumulated data. A study such as this would hopefully benefit the singing voices of the participants and give female singers additional resources as they work to sustain their vocal technique throughout menopause.

Conclusion

Menopause and its symptoms, especially changes that impact vocal characteristics, is still a relatively new area of research. Changing hormone levels due to menopause can significantly impact the vocal mechanisms, causing a lower fundamental frequency and vocal quality changes such as roughness or hoarseness. For many women, these physical and vocal changes can impact their quality of life. In 2013, researchers discovered that menopausal women reported significantly lower health-related quality of life and higher work impairment than premenopausal women (Whiteley et al., 2013). Professional and recreational singers are specifically impacted not only by the physical and psychological symptoms of fatigue, depression, and anxiety, but also by vocal changes that impact their career or activities. A wider understanding and knowledge of vocal changes is necessary to help all women navigate the symptoms that can impact their work or life throughout menopause.

Today, researchers and vocal experts are delving deeper into the hormonal changes of menopause and their impacts on the voice. Although we now have more understanding on the common vocal menopausal changes, future research is needed to determine if women can use specific, targeted practices and exercises to strengthen and improve their vocal skills throughout menopause. Singers, especially, could benefit from programs that help to prevent changes in tone, respiratory support, and pitch range. With society's longer life expectancies, women are living almost a third of their lives post-menopause, and many continue a career long past menopause. It is essential for both the medical and artistic world to continue to research the vocal symptoms of menopause and begin to develop strategies that will help women thrive in their careers, hobbies, and goals throughout their entire lives.

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