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Still singing after all these years – A Perceptual Study of Post-menopausal Singing Voice Behaviors with Implications for Singers, Voice Teachers, and Choral Conductors

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Abstract

This study examined $N = 23$ post-menopausal singers through a questionnaire that addressed twenty-four aspects of vocal behavior, hormone therapy use/non-use, and typical singing mode, as well as other demographic information. It follows and was prompted by my 2010 doctoral dissertation, which examined $N = 307$ women's voices in pre-, peri-, and post-menopausal lifespan stages. The purpose of this study was to investigate perceived singing voice changes during post-menopause in cisgender women singers a decade or more after the menopausal event. Results included behaviors regarding voice function (loss of high range and loss of vocal stamina, difficulty in singing high and softly, and difficulty with onsets), vocal health (concerns included partial paralysis of the folds, reflux, hoarseness, and several respiratory ailments), and concerns/rewards of singing during the post-menopausal hormonal stage of life as discussed by the participants in narrative responses (52 discrete comments). Limitations of the study are stated. Pedagogical considerations include range and practice protocols and choral rehearsal techniques for promoting optimal vocal health for mature cisgender women singers.

Keywords: post-menopause, vocal health, singing, voice, hormones, rehearsal protocol, practice protocol, vocal aging

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Choirs around the globe are populated with women whose singing voices may have changed as they have aged. The post-menopausal lifespan stage often means diminished hormone levels, stiffer muscles, lessened ribcage compliance for breathing, loss of high (and sometimes low) range for singing with a corresponding lowering of the speaking fundamental frequency, as well as difficulty in singing softly, especially when singing higher pitches, among other complaints (Abitbol et al., 1999; American Lung Association, 2018; Davis, 2004; Ferraz et al., 2013; Gorham-Rowen, 2002; Vigil, 2015). Yet, these women still want to sing and contribute to their choirs with their musicality, musicianship, life experience, and with voices still capable of expressive beauty.

The purpose of this study was to investigate perceived singing voice changes during post-menopause in cisgender women singers a decade or more after the menopausal event. The study surveyed $N = 23$ post-menopausal singers, asking for demographic information, typical singing modes (i.e., soloist, choir member, teacher, a combination of these), and a self-report assessment on 24 different aspects of singing behaviors and qualities.

Review of Literature

Hormonal changes and loss of estrogen, during the menopausal stages of peri- and post-menopause, specifically, impact a singer's voice and can do so dramatically (Abitbol J., & Abitbol B., 1998; Abitbol et al., 1999; D'haeseleer et al., 2011; Davis, 2004; Friedman, 2011). Abitbol et al. (1989) revealed this influence in showing the close similarity between cervical and vocal fold compositions using cytological comparisons. Because the potentially decade-long process of peri-menopause and the subsequent post-menopausal stages result in hormone loss as well as generalized aging, deleterious voice change often accompanies the later decades of a woman's life (Abitbol et al., 1999; Astramowicz & Pajor, 2012; Khare, 2016). As one example of physical change affecting singing, Davis (2004) reported that respiration capacity reduced 40% between the ages of 40 – 80. With the average age of menopause in the U.S. being 51 years (Mayo Clinic, 2020), the aging process combined with dramatic hormonal changes makes a singer's breathing demands potentially much more difficult.

The vocal mechanism is highly influenced by hormones as can clearly be seen by adolescent male voice change. This male voice change is recognized as remarkable for many with voice breaks, laryngeal instability, hoarse voice quality, and diminished range until the change is mostly complete (Cooksey, 1999). Many peri-menopausal women have a similarly extreme experience, though that fact is not widely known (Abitbol et al., 1999; Bos et al., 2020).

Abitbol et al. showed in their 1989 study that cytological smears of the cervix as compared to the vocal folds showed remarkably similar, if not identical, composition. This discovery expanded how the voice was viewed with the new understanding of the larynx as a mechanism highly influenced by sexual hormones. For women, these were primarily

estrogen and progesterone. Between the years of 1991 and 2002 (Women's Health Initiative [WHI], 2002), a short 11 years passed where hormone therapy (HT) was considered a helpful and relatively safe tool for preserving a more youthful voice quality.

The WHI study (2002), which examined over 161,000 women on hormone therapies, made recommendations regarding the use/non-use of HT and its influences on their general health. This longitudinal study was halted when the older participants (over 65 years of age) began to exhibit some serious health issues relating to heart, stroke, and breast cancer. Brigham Women's Hospital (2012), Lobo (2013), and Bos et al. (2020) have examined the WHI study more recently and have brought into question the wisdom of stopping the study for all participants, rather than only the oldest ones. Brigham Women's Hospital (2012) reported that HT use fell by 70% of previous use after the WHI report was published. The ensuing fear and uncertainty led to the immediate reduction of HT use across ages, though more recent research (Kadakia et al., 2013; Lobo, 2013) suggested that it may be safe and beneficial for many menopausal women. The positive effects of HT use included a reduction in mortality for younger women and those near the start of menopause, as well as protection from coronary disease and osteoporosis (Lobo, 2013). Those effects, which may also help menopausal women speak and sing with greater ease, were disrupted and in a sense, denied for a majority of singers over the past eighteen years.

Though there has been considerable research on general health for post-menopausal women, the effects of this lifespan stage on the singing voice have been underexamined. Current searches of the literature using such keywords as post-menopause, singing, voice, hormones, vocal folds, and vocal aging initially garnered only 31 articles, of which only one (Ferraz et al., 2013) was specifically about hormonal influence on the voice, and this was a speech study, not singing. Further investigation of more databases for articles, dissertations, and books produced 25 entries that focused on either menopause in general or its effects on the voice in the past decade. Those dealing with the speaking voice included, among others, D'haeseleer et al. (2012); Glaser et al., (2016), Rojas et al. (2020), and Sataloff and Kost (2020). Articles, dissertations, and books specifically dealing with the older (not necessarily post-menopause) singing voice numbered fewer than 20 and included Price (2010); Edwin (2012) Prakup (2012); Smith and Sataloff (2012); DeMaio (2013); Richie (2013); Vigil (2015); Elliott (2017); Brunssen (2018), and Bos et al. (2020). Of these, the largest studies in terms of participants were Price with $N = 307$ and Vigil with $N = 249$ participants.

Relatively little research had examined female singing voice in specific hormonal conditions (Abitbol et al., 1989, 1998; Abitbol et al., 1999; Lã & Sundberg, 2010; Lamarche, 2009). Protocols for building vocal health and technique had not been sufficiently developed specifically for female singing voices affected by peri- and post-menopausal phenomena (Stemple et al., 1994; Siarris, 2009).

Due to a paucity of research for female singing voices in various hormonal statuses, my dissertation in 2010 examined $N = 307$ female singers, disaggregating by pre-, peri- and post-menopausal statuses (Price, 2010), making it the largest study on female singing voices in light of hormonal stages with pedagogical considerations. The participants in

this research were all active singers – most singing in choirs, some taking voice lessons, and several teaching voice while maintaining a performing career. Most were choral singers by serious avocation. Their voices were analyzed acoustically by use of *VoceVista*, an acoustical software developed by Donald Miller and his colleague, Harm Schutte, in 1996 (Miller, 2008) and the Computerized Speech Laboratory (PENTAX Medical), which is frequently used in medical and speech/language therapy offices. Perceptually, voices were examined by analyzing three singing tasks: sustained /a/, glided siren from low to high and back, and a phrase of a song. They responded to three questionnaires: The Singing Handicap Index (Cohen et al., 2007) a Vocal Context Survey (Price, 2010) and a Voice Change History (Price, 2010), and they shared their menopausal stories if they were peri- or post-menopausal. An expert listening panel was employed to gauge voice production on a scale of “breathy” to “pressed.” A particular focus was the influence of hormones and whether or not these singers were participating in or had participated in hormone therapy.

My 2010 study revealed some significant effects that are also meaningful to the current 2020 study. They include (a) pre-menopausal singers (acoustically and perceptually), who showed a significantly higher mean pitch range (measured in cents) than peri- or post-menopausal singers; and (b) non-HT users, who had a significantly larger overall range than HT users. This counter-intuitive statistic may be explained by the added lower range for most non-HT users with some post-menopausal singers with a low pitch end of A#2. Perceptually, (a) post-menopausal singers commented significantly more on the vocal source (laryngeal) issues with concern than did peri- and pre-menopausal singers; (b) singers on HT had significantly higher mean ratings (ratings closer to a balanced score from breathy to pressed) than those not on HT by an expert listening panel; and (c) choristers expressed a significantly higher number of comments on voice concerns than soloists (Price, 2010).

Based on range testing in the 2020 study for N=307 singers, Table 1 on the next page shows the changes in median high and low pitches for each menopausal status. It is notable that there was a drop in mean high range pitch from C6 in pre-menopausal singers to A#5 for peri-menopausal singers, and then both a return to C6 for post-menopausal singers on HT and a larger drop to F#5 for post-menopausal singers not on HT. Additionally, the non-HRT post-menopausal singers had an increase in lower range to as low as A#2 (overall range, not a mean).

Ten years after this study, I wished to replicate the 2010 study for a small subset of singers facing aging vocal effects in the post-menopausal hormonal stage. Post-menopausal singers are an underserved population in terms of research. However, due to the coronavirus (COVID-19) and subsequent pandemic, meeting with singers personally was not advised. Additionally, very few protocols were set in place in the first months of the pandemic with the resulting societal disarray; and therefore, I determined it was wise to narrow this update to an email questionnaire of the post-menopausal singers. The questionnaire was built upon the review of literature and the concerns and data of the peri- and post-menopausal singers from the previous study. This study investigated post-menopausal singing behaviors a decade or more after menopause to reveal voice behaviors, concerns, and benefits in singing.

Table 1.

Range Means and Modes Given in Pitch for Upper and Lower Singing Limits for Pre-, Peri-, and Post-Menopausal Singers, with and without HT.

Hormonal Status	Upper Means	Upper Modes	Upper Range	Lower Means	Lower Modes	Lower Range
Pre	C ₆	D ₆	C [#] ₅ - B ₆	F ₃	F ₃	C ₃ - A ₄
HRT Peri	A [#] ₅	A [#] ₅	F ₅ - C [#] ₆	F ₃	D ₃	C [#] ₃ - A ₃
Non-HRT Peri	A [#] ₅	A [#] ₅	A [#] ₄ - G [#] ₆	F ₃	E ₃	B ₂ - C ₄
HRT Post	C ₆	D ₆	C ₅ - E ₆	E ₃	D ₃	C [#] ₃ - C ₄
Non-HRT Post	F [#] ₅	B ₅	A ₄ - F ₆	F ₃	F ₃	A [#] ₂ - D ₄

Note: Bold type indicates lowered upper-range limits. The red type indicates the high range equivalence between pre-menopausal singers and post-menopausal singers on HT.

Method

Participants

This study was approved by Rider University's Institutional Review Board and all participants consented. The participants were a sample of convenience drawn from singers who were known to the researcher and had participated in the 2010 study. These singers ($N = 23$) were cisgender women with a mean age of 65 years (range 60–82 years). The mean length of time since the menopausal event was 14.6 years.

Though most participants currently regard themselves as choral singers (see the results below), 100% of these singers have taken or are taking private voice lessons. The mean for years studied is 18, the range is 3 months to 55 years, and the mode is 10 years. The length of time since the last voice lesson for each varied from those still taking lessons to the last lesson having been taken 52 years ago. The mean for that hiatus from lessons was 16.6 years with the median being 11 years. Nearly half (47%) of these participants were either still taking lessons (longest lengths of study: 55, 43, 38, 35, 32 years) or had stopped within the past one or two years. A requirement of participation in the study was that one had to be actively singing: practicing, rehearsing, and/or performing at least twice weekly.

Measures and Procedure

Due to the coronavirus limitations, the current study was conducted as an online questionnaire (see Appendix A) that queried singers about their (a) menopausal status; (b) use or non-use of hormone therapy (HT); (c) their perceptions of their own voice status (soloist, choral singer, voice teacher, choral conductor); (d) voice study; (e) voice description; and (f) voice function behaviors. The questionnaire was emailed to 25 singers and $N = 23$ post-menopausal singers responded. The 2 who did not return the questionnaire stated that they were not actively singing, a requirement of the study. Surveys were returned either via email or through the postal service.

Results

Of these 23 singers, nine participated in hormone therapy (HT) at some point during their peri- and/or post-menopause for an average length of participation being six years (range: .5 – 22 years). One participant, #17, currently 70 years old, only ceased using HT two years prior to the study. Another, participant #1, had to cease HT after 17 years of use due to a recurrence of cancer that was estrogen receptive. As all participants were post-menopausal, it is noted that only four of them had a surgical menopause: numbers 1, 2, 4, and 21. Three of these had an oophorectomy at the same time (removal of ovaries, and therefore a dramatic loss of hormones). Additionally, of the four women who had a surgical menopause, three, or 33% of the 9 HT participants, had used HT.

Of these nine who have taken HT, only one had since returned to hormone therapy for the past year. She had participated in HT during peri-menopause for 5 years, stopped, and resumed at age 63 (nine years after having stopped) due to “viral and hormonal symptoms (that) reduced the quality of my life significantly” (comment of participant #4). Since resuming HT, she had “no concerns.” She stated that there was “significant improvement in degrees of dizziness, no more vertigo or migraines, reductions in heart palpitations and hormonal brain fog” (questionnaire comment, see Appendix A).

When those who had used HT previously were asked about their feelings regarding resuming it, the following comments were given:

1. “Would consider it again”
2. “Stopped when report linked it (HT) to cancer”
3. “Dangerous”
4. “I miss it!”

The reference in #2 and likely #3 was to the National Institutes of Health 2002 Women's Initiative (WHI) report that studied more than 161,000 post-menopausal women (50 - 79 years of age, mean of 63). The WHI study concluded that HT (typically at that time, Premarin and Prempro, which were common HT prescriptions) increased risks for post-menopausal women for breast cancer, heart disease, stroke, blood clots, and urinary incontinence (WHI, 2002). The WHI study was impressively large, but results for older participants were assumed for younger women as well (see the above review of literature).

Table 2 shows the types of hormone therapy used by the nine women who had participated in HT and were represented in this study. Length of use is listed in total use rather than specifically by HT type as most participants could not remember exact amounts or length of use for individual types. It is to be noted that six of the nine HT users were on the prescription Premarin, which constitutes 67% of the HT participation.

When asked how they currently describe their singer status, 17 of 23 (74%) chose "Choral Singer," two selected "Soloist," two chose "Voice Teacher," one selected "Both Soloist and Voice Teacher" and one chose both "Choral Singer" and "Soloist," separately. See Figure 1 on the next page for a visual representation of these divisions.

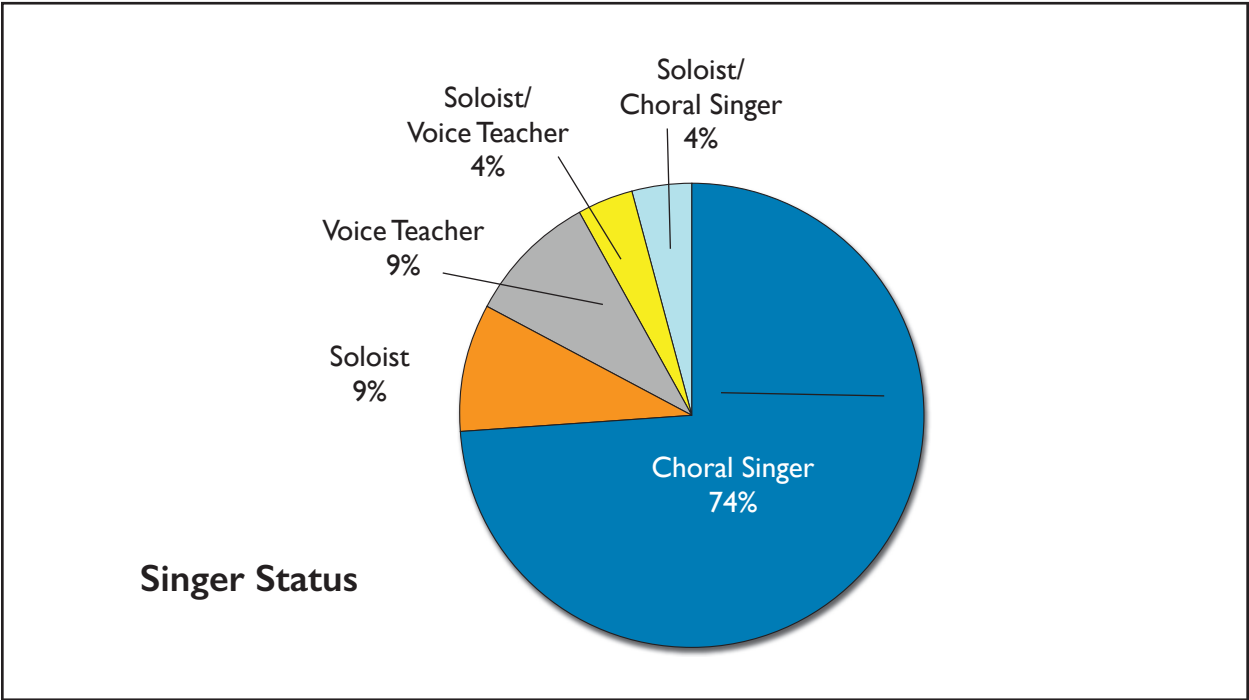
Table 2.

Singer ID# for Each Participant on HT, HT Type, and Duration of Use.

	Premarin	Progestin	Estradiol pill	Estradiol patch	Bio-Identical	Vitamins	"Supplements"	Cannot remember
Singer ID #								
1	17 years							
2								6 months
4			5 years on, 1 year off, now resumed					
10	1 year							
11	6 months							
12					1 year			
13	2 years							
16	4 years							
17	22 years							

Note: Shaded blocks indicate use of that particular HT by that participant.

Figure 1
Singer Status as Self-described, N = 23.



One portion of the questionnaire (see Appendix A) was a series of 24 perceptual descriptors of voice production, function, and quality asking participants about onsets, range, *passaggi* (a range of pitches during registrational transitions), dynamics, stamina and fatigue, hoarseness, phonation, intonation, voice breaks, and speaking voice. There were options to respond about concerns as well as feelings of confidence in voice use. Table 3 shows how participants responded.

Table 3.
Questionnaire Statements of Vocal Health and Function

Statement	# of Responses of 23 Participants
I am not “hoarse” any more now than I was in pre-menopause	15
High range is diminished	14
My speaking voice feels the same in pitch as during pre-menopause and is not uncomfortable	14
Onsets feel easy and balanced	13
Vocal stamina is diminished from what it was in pre-menopause	11

Vocal fatigue is no more common now than pre-menopause	11
My voice never or rarely “breaks”	11
Low range (“chest voice”) is easier	11
Passaggi areas (transitions between registers) feel more unstable than in pre-menopause	10
It is more difficult to sing softly, especially high and soft	10
I occasionally have pitches not “sound” or stop sounding after I’ve begun to sing	10
Achieving or maintaining pitch is no greater a problem than during pre-menopause	10
Onsets can be rough or effortful	9
It is the same or easier to sing softly, especially high and soft	9
I have no problems with phonation (beginning and continuing vocal sound)	9
My voice sometimes “breaks”	9
High range remains intact	8
Passaggi areas feel as stable as during pre-menopause	7
Vocal stamina is the same or better than it was during pre-menopause	6
Vocal fatigue has become much more common	6
Achieving or maintaining pitch is occasionally or frequently a problem for me	6
Low range (“chest voice”) is more difficult	3
I am often “hoarse”	2
My speaking voice feels lower in pitch and sometimes uncomfortable	2
<i>Note: Data is shown from greatest to least in number of responses; more negative statements are in bold; the italics statement on range indicates change, but is not negative.</i>	

To summarize, there were 12 positive statements and 12 less positive or, perhaps, negative statements from which to choose. The positive statements outshone the negative ones in a frequency count of 124 to 92 (216 total comments). As Table 2 demonstrates, the statement that was most frequently selected was “I am not any more ‘hoarse’ now than I was in pre-menopause” with 15 discrete answers. Other positive comments were that the speaking voice remained essentially the same as pre-menopause (14 answers), that onsets were easy

and balanced (13), and that there was no greater vocal fatigue (11) or frequency of voice breaks (also 11) than in pre-menopause. Another positive choice was the statement that the low range (chest voice) was now easier in post-menopause (11). Though one could say from research that loss of estrogen is a contributing factor of that ease, it could still be considered a positive development for the voice.

Negative behaviors that received the most responses include the statements that high range (14 answers) and vocal stamina (11) had both diminished. Participants also reported that passaggi areas felt more unstable than pre-menopause (10), it was more difficult to sing softly – especially high and softly (10), and that pitches occasionally did not sound immediately at onset or stopped sounding after phonation began (10).

One question that required a narrative response asked what descriptive words each singer would use to currently describe their voice. I conducted a content analysis revealing 52 discrete comments with 41 of those dealing with concerns or complaints and 11 being positive comments about voice use. Of those 52 comments, 23 (roughly half) were about phonation with 15 of the 23 being concerns regarding it. This response is particularly interesting as there were nine comments of the 23 in the comparative statement answers above that indicated “no problem with phonation.” Of course, there are likely nine participants who feel no problems with phonation. Still, when asked to name for themselves some of their voice descriptors, the following words and phrases were written: “hoarseness,” “middle voice hoarse” (two times), “middle doesn’t phonate,” “middle voice is unreliable,” “sustaining hard,” “phonation is unreliable,” “registration breaks,” “hard to overcome,” “uneven,” “nothing comes out,” “more difficult” (two times), “voice breaks,” and “warming up is necessary.”

The next largest group of comments dealt with vocal health concerns (10 comments, all concerns). The concerns encompassed partial paralysis of the folds, arthritis, bronchitis, reflux, congestion, allergies, asthma, and COPD. The next most populated category was singing range with six of the seven comments stating a loss of high range. The last two categories addressed vocal fatigue/tension (5 negative comments) and breathing concerns (3).

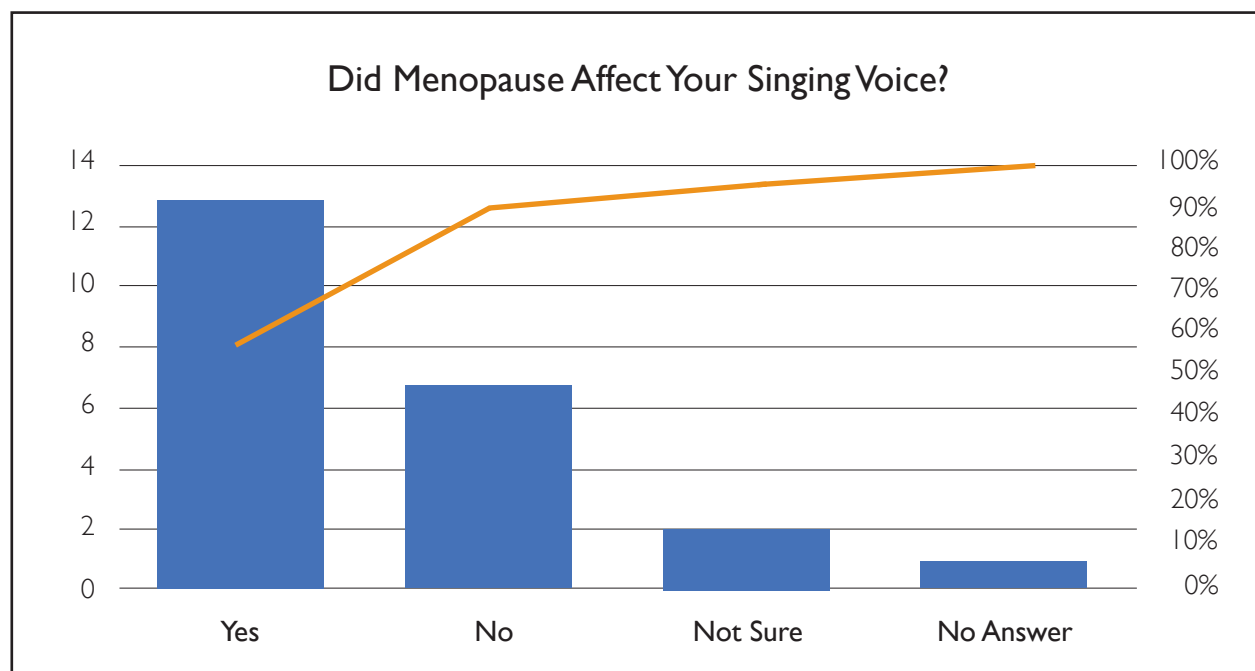
Finally, two questions were asked:

1. Did you begin or return to lessons due to vocal concerns?
2. Do you believe menopause has affected your singing voice?

For the first, six (26%) of the 23 women said they did begin or return to lessons because of vocal concerns during these periods of their lives (peri- and post-menopause). For question #2, 13 (56.5%) of 23 women responded that they did feel menopause affected their singing voice. Seven (30.4%) women believed it did not, and two (8.7%) were not sure of the cause of vocal change (menopause, general aging, illness). One (4.3%) participant did not answer this question. Figure 2 on the next page gives a visual representation of these personal answers.

Figure 2

Responses of $N = 23$ female singers answering: *Did menopause affect your singing voice?*



Discussion

Because of the laryngeal response to sex hormones, larynges grow at puberty and female ones decline at menopause with its precipitous drop in estrogen and progesterone. The desire to sing as one did before menopause is compelling as our voices represent a part of our self-identity. For both these reasons, it follows that singers who want to retain as much of their singing voices as possible would consider taking hormone therapy. Though 39% of the participants had used HT, it is revealing that only two (#1 and #17) participants remained on HT for a long period of time (17 and 22 years, respectively). It is also notable that one participant (#4) has chosen to return to HT and is currently very happy (self-report) with her choice. Through conversations by the researcher with singer-colleagues (Bos et al., 2020) and older students, it appears that there are more women considering this option now, after a long hiatus from HT. The reason? Quality of life. The reason for singers? Quality of life and improved singing voice.

Among these 23 singers, 74% of whom self-designate as primarily choral singers, there were 124 (57.4%) positive comments made about their own voice function and health and 92 (42.6%) negative comments. These positive comments are encouraging. It may be that for this cohort of 23 women, much of the instability and dismay of peri-menopausal years has quieted and the joy in singing has reemerged in post-menopause. However, though this statistic represents a majority in terms of positive comments, there are still 92 (over 40%) negative comments, which are not to be ignored.

From the singers' self-described voice characteristics as elicited from the statement "Words I would use to describe my voice production (how easy it feels to phonate/sing) are _____," specific vocal descriptions emerged from these 23 female singers. As in the 24 statements on voice function and health, these descriptors included words such as "easy, smooth, easy onsets, and same as during pre-menopause." They also commented that they worried about "unreliable voice," "hoarseness," "difficulty (in singing)," "hard to overcome," "less high range," and "more fatigue." Again, a disconnect existed between these singers and their perceptions regarding their post-menopausal voice function and health. An understanding among peri- and post-menopausal singers of the role of hormones in their vocal production is long overdue.

Additionally, of these dedicated singers (100% of them have studied or do study voice privately, and 74% of them consider themselves primarily choral singers), 26% began or returned to voice lessons when they felt something amiss vocally in peri- or post-menopause. More than a quarter of these 23 singers sought professional assistance to help them navigate this lifespan vocal stage, whether they identified it as a "stage" for themselves or not. It is particularly impressive to me that 100% of participants have studied or do currently study voice privately.

There were various responses to the question that asked if the participants believed menopause had affected their voices. If the small percentage of women (8.7% of participants) who were not sure what caused the change were combined with the one no-answer participant (4.3% of participants) as well as those who believed in this effect (56.5%), then 70% of the participants felt that menopause, or something in that time frame, changed their voices. Thirty percent said "no," it did not. Yet, despite these vocal changes and the need to adapt once again, 23 of the originally solicited 25 participants reported actively singing. This statement is a tribute to both their fortitude and their love of singing.

Pedagogical Considerations

Range Guidelines

This new study looked specifically at post-menopausal singers. For the participants in the original study, I created a protocol based on ranges of the 307 singers as seen in Table 4 on the next page. These are suggested ranges for singers as they are vocalizing, for voice teachers as they teach post-menopausal singers (and singers in other menopausal stages), and for choral directors during choral warm-ups and as they select repertoire to keep in mind. For repertoire choices, it is advised to recall that these are upper and lower vocalizing limits, and not a range for a solo or choral piece. However, by reducing the upper and lower limits by several semitones, one may find the acceptable singing range. Also, it should be stated that many singers will not be able to sing these high and low limits. It is advised not to go higher or lower than these for most singers. Stay within what is freely and easily produced by any given singer, understanding that physical energy and connection are always needed for healthy and effective singing.

Table 4.*Suggested Guidelines for Vocalizing Ranges for Pre-, Peri- and Post-Menopausal Singers.*

Stage	Upper Limits Vocalizing Range	Lower Limits Vocalizing Range
Pre-menopause		
Soprano:	$C_6 - E_6 + \text{whistle register}$	$F^\#_3$
Mezzo/Alto:	$A^\#_5 - C_6$	F_3
Peri-menopause		
Soprano:	$A^\#_5 - C_6$	$G^\#_3$
Mezzo/Alto:	$G_5 - A^\#_5$	F_3
Post-menopause		
Soprano:	$B_5 - D_6$	$F^\#_3$
Mezzo/Alto:	$F_5 - A^\#_5$	D_3

Note: Post-menopausal singers are in bold as they are the focus of the current study.

Rehearsal and Practice Protocols

Rehearsal and practice protocols can be suggested based on the data from the 2010 and 2020 studies. Before the rehearsal begins, repertoire should be chosen with the age and menopausal stage (pre-, peri- or post-) of the choristers in mind. A warm-up routine at the beginning and a cool-down routine at the end of these periods of athletic vocal use are essential.

For post-menopausal singers, singing in a high range is often tiring and, at times, not possible. Singing in the high range constitutes the most difficult vocal demand, especially at soft dynamic levels. These statements are not to say that range must be severely limited (see both Tables 1 and 4). However, high tessitura and frequent, sustained, high pitches are not recommended. A “visit” to a high note or shorter, high passage can be fine.

For long passages on one breath, post-menopausal singers may find the vocal mechanism drying and tiring as reported in questions on vocal fatigue and supported by literature (Davis, 2004). The dry vocal mucosa (hormone loss) requires more frequent respiration to vibrate freely. Therefore, more frequent breaths within a phrase or section are required.

Typical lengths of rehearsals and practice sessions require us to consider their organization and priorities. Because vocal fatigue/stamina issues are part of peri- and post-meno-

pausal stages, as well as older mature voices in general, the amount of voice use in a practice session or a rehearsal matter. The best practices that I recommend are 10 – 15 minutes of singing or speaking (speaking text in rhythm, counting aloud, etc.) at a time, interspersed with other non-voice activities. These activities could involve listening to recordings, marking breath and diction in the scores, clapping/tapping rhythm or beats, learning about the historical background of a piece, and discussing interpretive suggestions from the teacher or conductor. Voices in general, and particularly voices in hormonal change, find long rehearsals with consistently sustained voice use challenging. Sixty to 90-minute rehearsals, organized as described, are typically much more productive than a two to three-hour block. More frequent, shorter rehearsals are recommended. The same is applicable of practice and voice lesson duration. Variety is indeed the spice of life that is most conducive to comfortable vocalism.

Two more musical or aesthetic choices need to be mentioned here. Due to hormone loss, voices become less agile and melismas, therefore, become more challenging. The good news here is that agility exercises can help these voices move more effectively. Melismas can be divided into more manageable units with different singers assigned differing groups. Also, the other aesthetic, sometimes considered historically based, is straight-tone singing. Older voices of all sorts find this controlling of their naturally developed vibrato to be tiring since it often involves a restricting of vocal freedom. Just like high, sustained passages, occasional moments or phrases with reduced vibrato can be fine. Entire pieces in this mode are often not conducive to beautiful tone among post-menopausal singers.

Limitations of Study and Future Directions

Limitations of this study included the inability to obtain certain acoustical, airflow, and mechanical measurements due to the COVID-19 crisis during 2020-2021. Because of the pandemic, the study relied on self-report. The small convenience sample size was a limiting factor, and there was a variance in private voice study by the participants, some studying continuously, others taking a hiatus, and still others studying for only a short time. These are confounding variables that are not controllable in this study, nor, indeed, are they customarily controlled in a choral setting.

However, what this study does support is the growing body of literature that has revealed the effects of hormone loss, affecting voice behavior. This awareness of hormonal influence on the voice in middle and later life is critical for singers, teachers, and conductors to embrace. Future directions could focus on testing hormonal levels in singers as well as reassessing the protocols of hormone therapies in light of voice use. Acoustical and airflow assessments should also be resumed.

Conclusion

This generation of post-menopausal singers has been at the center of the reaction to the WHI (2002) study, halted early due to fear of negative health consequences. Though many

researchers now believe the reaction to stop hormone therapy for so many women was too conservative, the reality is that most women did follow doctors' orders and ceased taking HT, or never began, and suffered the full range of menopausal symptoms. These symptoms culminated for many in the loss of the voice's ability to retain its more youthful function for a longer period of time – a gift of HT. For present and future singers, it may be that HT can be considered an optional choice once again.

For this study's 23 participants, loss of high range and loss of stamina ranked first and second in reported issues. Four complaints of voice behavior tied for third place: singing softly and singing high and softly simultaneously, instability at passaggi points, onsets and continuance of phonation, and vocal health concerns. Singers, voice teachers, and choral conductors can address these concerns by selecting repertoire that is kind to the post-menopausal voice: limiting a high tessitura, selecting shorter pieces, requesting "straight-tone" as an ornament, rather than a sustained activity, and encouraging good vocal hygiene for their singers (i.e., sufficient hydration and sleep, practicing frequently in short time spans, etc.). Additionally, practice sessions, voice lessons, and choral rehearsals can all be adjusted to create sessions that promote vocal ease and, therefore, more vocal beauty.

Comments reflected the anxiety these singers feel with their current voices: "unreliable voice," "hoarseness," "difficulty (in singing)," "hard to overcome," "less high range," and "more fatigue." However, there were more positive than negative comments from this group of women with a mean age of 65 years (124 positive to 92 negative), perhaps suggesting that there is a pleasure in singing that was not reported by peri-menopausal singers previously (Price, 2010). Post-menopausal singers may characterize their voices as less reliable, particularly with a loss of high range and stamina as well as more health concerns than previously, but many also feel an easier, freer phonation and greater stability return.

Singers, voice teachers, and choral conductors all benefit from understanding how the voice navigates the hormonal and aging stages of vocal life. Through research we can be aware of protocols that enable better vocal behaviors that make practicing, rehearsing, and singing more enjoyable, effective, and beautiful during this post-menopausal stage of singing life.

Appendix A

(Your ID number will be added by the researcher): # _____

I participated in K.K. Price's dissertation research in 2009/10 (yes or no): _____

Questionnaire for Dissertation Follow-Up Study June 2020

Article Title: "Still singing after all these years" – A perceptual study of post-menopausal singing voice behaviors with implications for singers, voice teachers, and choral conductors

Author: Kathy K. Price, Ph.D.

For publication in: *The International Journal of Research in Choral Singing*

Please answer the following questions about your menopausal/hormonal status:

1. My sex is _____ .
2. How would you describe your gender?
 - a. Female including transgender women
 - b. Prefer to self-describe as _____
(non-binary, gender fluid, agender, prefer not to say)
3. My birthdate (Month/Day/Year): _____
4. To the best of my knowledge, my menopausal stage is (please choose from the list/definitions below): _____

Pre-menopause – The period of early female adult life from the first menstrual period to the onset of peri-menopause

Peri-menopause – A time when hormonal changes begin to move the body toward cessation of periods. Possible symptoms include irregular periods, hot flashes, mood-swings, and poor sleep. It generally lasts 4 years to ten years, most commonly during one's 40s - 50s.

Post-menopause - It has been 12 consecutive months or longer since the last menstrual period.

5. If peri-menopausal, how long do you perceive you have been in this stage? (years/ months): _____
6. If post-menopausal, how long have you been in this stage? (years/months): _____
7. If post-menopausal, was your menopause surgical? _____ If so, at what age did you have the hysterectomy? _____ Did your surgery include an oophorectomy? _____
8. Have you ever participated in hormone therapies (HT, previously called HRT or hormone replacement therapy)? (yes or no): _____

(If you answered “no” to #8, you may skip question 9 and go on to the next section of questions.)

If yes to #8,

- a. What sort(s) of HT have you taken or are you taking? _____

(Please include prescription, homeopathic alternative choices, and dietary supplements)

- b. How long have you been on (or were on) HT (Years/Months) _____?
- c. Are you still on HT? _____ (yes or no)
- d. Do you fit the description of someone who has been on HT previously, stopped, and then began again more recently? (yes or no) _____ ? If yes, why did you resume? _____
- e. What are your current impressions, concerns, and feelings about resuming HT? _____
- f. If you answered “yes” to question 9d above, would you be willing to have a short phone or Zoom conversation with me about your experience with returning to HT? _____ (Circle one: yes, no, would like more information)

Please answer the following questions regarding your singing:

1. At this point in my life, I consider myself to be:
 - a. Primarily a soloist
 - b. Primarily a choral singer
 - c. Primarily a voice teacher
 - d. Primarily a choral conductor
 - e. Both a soloist and a voice teacher (mostly 50/50)
 - f. Both a choral singer and a voice teacher (mostly 50/50)
 - g. Both a soloist and a choral conductor
 - h. Both a choral singer and a choral conductor
2. I have _____ have not _____ taken individual voice lessons in my life.
(Please check one.) *If you answered "I have" above:*
 - a. How many years have you studied? _____
 - b. What year did you **last** have a voice lesson or coaching? _____

Please answer the following questions about your voice:

1. Words I would use to describe my voice production (how easy it feels to phonate/sing) are: _____

2. Menopause (whether you are peri or post) has affected my singing voice: (yes or no) _____
3. Please circle the letter on all that apply:
 - a. Onsets (how the tone begins) can be rough or effortful
 - b. Onsets feel easy and balanced
 - c. High range is diminished
 - d. High range remains intact
 - e. Low range ("chest" voice) is easier
 - f. Low range ("chest" voice) is more difficult
 - g. Passaggi areas (transitions between registers) feel more unstable than pre-menopause
 - h. Passaggi areas (transitions between registers) feel as stable as during pre-menopause
 - i. It is more difficult to sing softly, especially high and soft
 - j. It is the same or easier to sing softly, especially high and soft
 - k. Vocal stamina is diminished from what it was during pre-menopause
 - l. Vocal stamina is the same or better from what it was during pre-menopause
 - m. Vocal fatigue (larynx "feels" tired) has become much more common
 - n. Vocal fatigue (larynx "feels" tired) is no more common now than pre-menopause

- o. I am often “hoarse”
- p. I am not “hoarse” any more now than during pre-menopause
- q. I occasionally have pitches not “sound” or stop sounding after I’ve begun to sing
- r. I have no problem with phonation (beginning and continuing vocal sound)
- s. Achieving or maintaining pitch is occasionally or frequently a problem for me
- t. Achieving or maintaining pitch is no greater a problem for me than during pre-menopause
- u. My voice sometimes “breaks”
- v. My voice never or rarely “breaks”
- w. My speaking voice feels lower in pitch and sometimes uncomfortable
- x. My speaking voice feels the same in pitch as during pre-menopause and is not uncomfortable

If you do NOT feel you have any vocal concerns or issues due to your menopausal stage, you have finished this questionnaire. Thank you so much for your time and for helping to continue research on the lifespan female voice and menopausal influences.

If you feel you ARE HAVING or HAVE HAD menopausal vocal concerns and issues, please answer the remaining questions as they apply to you.

1. Concerns about my singing voice led me to begin _____ or return _____ to voice lessons (please check one).
2. Because of vocal change, I have changed my choral designation/vocal fach from _____ to _____ .

Thank you so very much for your contributions to this research. As someone who has experienced a lot of vocal change through my life’s singing journey, I thank you for helping other women of similar experience understand this life-change and embrace ways to continue singing beautifully and joyfully throughout our lives.

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