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PREGNANCY AND THE VOICE:
SURVEYING EFFECTS FROM THE SINGER'S PERSPECTIVE

by

Sarah Harper

A DMA Document

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Acknowledgments

This project stemmed from discovering a lack of research on pregnancy and the voice presented in a tangible way for women currently in the singing field. Through study of recent scientific publications on the subject, I found a need for research related to the information women receive about the effects of pregnancy and the voice along with anecdotal source material on what they actually experience. During the process of investigating this topic, many women have come forward to share their stories, hoping that it may help future pregnant women in the professional singing field. I, too, hope that the results of the survey may open up opportunity for future research on the topic and further investigation on the correlation between pregnancy and vocal changes.

This project would not have been possible without the support of Dr. Kyle Ferrill, Dr. Miriam Van Mersbergen, and Alexis Payne alongside the other doctoral committee members, Dr. Kenneth Kreitner and Mary Wilson, who have all provided patient advice and guidance through this research process.

I would also like to acknowledge my husband, who has shown his unwavering support and love through this process, always encouraging me every step of the way. To my parents, who have provided the means and support for me to pursue this level of education, I would not have been able to achieve this level of academic success without you. To all others who have supported, guided and encouraged me throughout my academic pursuits, I sincerely thank you.

Abstract

Hormonal challenges and physical encumbrances tax a woman's body during pregnancy. If that woman is a vocalist, these changes will affect her ability to sing. Assumptions exist about what can happen to a woman's voice during pregnancy, but these assumptions are based on theoretical predictions of what happens to the voice during pregnancy. This investigation aimed to gain information on what women were told about the effects of pregnancy on the voice in comparison to what they actually experienced. An anonymous mixed-method survey was distributed to 321 professional women singers; results will be discussed.

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Introduction

Pregnancy and delivering a baby are among the most physically demanding things a woman will ever experience. But it is also an invigorating and exciting time in a woman's life. With all of the physical demands of housing a developing child, every aspect of a woman's body is affected. A dramatic increase in sex hormones exacerbates these physical demands. Since a singer's instrument is her entire body, these physical and hormonal changes cannot help but affect her singing voice and the efficiency of her instrument. According to Hancock and Gross, "understanding how pregnancy affects the voice and the periods when the voice is most affected will allow speakers and singers to be informed of why these difficulties are occurring and when a more careful voice [accommodation] is required."¹ The goal of this project is to foster a discussion of these physical, hormonal, and vocal changes that occur during pregnancy and gather current information on how one might continue to healthily sing during gestation and postpartum.

¹ Adrienne B. Hancock. and Heather E. Gross, "Acoustic and Aerodynamic Measures of the Voice During Pregnancy," *Journal of Voice* 29, no. 1 (January 2015): 53-59.

PART 1: HORMONES, PREGNANCY AND THE VOICE

Hormonal Overview

Over the course of a lifetime, women are subjected to a wide range of hormonal influences. From conception through puberty, all the way to menopause, the presence of hormones dictates a person's sex, growth patterns, fertility, and general well-being. Once a girl has reached full maturation, she is subjected to the cyclical fluctuations of sex hormones each month. There are two occurrences which eliminate this hormonal cycle: menopause and pregnancy. During the female menstruation cycle, the fluctuating levels of estrogen, progesterone, and androgens can occur. This is exacerbated even more during pregnancy as hormones drastically increase, and during menopause when hormones drastically decrease.²

Hormones are part of the endocrine system, making up the body's primary chemical messengers. Produced by the endocrine glands throughout the body, hormones "are natural chemical signals synthesized from specialized groups of cells to influence bodily functions... and are involved in the dynamic control of biochemical and physiological functions."³ When balanced, hormones normalize regular bodily functions and help to maintain a positive, healthy well-being. According to Rattan, "hormonal imbalance creates an upset in the regulatory mechanisms, thereby disturbing the homeodynamic balance."⁴ Specifically, sex hormones are

² Ofer Amir and Tal Biron-Shental, "The Impact of Hormonal Fluctuations on Female vocal Folds," *Current Opinion in Otolaryngology* 12, no. 3 (2004): 180.

³ Suresh Rattan and Ramesh Sharma, *Hormones in Ageing and Longevity*, (Cham: Springer International Publishing, 2017), v.

⁴ Ibid.

present in both males and females, with different purposes and in varying amounts. The primary female sex hormones are estrogen and progesterone, although females do have small amounts of androgens such as testosterone. Just as an imbalance of any hormone can cause health problems, so too an imbalance of sex hormones can impact more than just the reproductive system.

According to Amir and Biron-Shental, “sex hormones are produced from cholesterol through several enzymatic pathways (progesterone is a precursor of androgens, which in turn are precursors of estrogens). [These] hormones act through specific receptors, located in their target organs, and are responsible for the development and functioning of the genital organs, fertility, bone density, and blood lipids profiles.”⁵ Estrogen is the primary hormone in developing female sexual characteristics, serving as the catalyst for female development during puberty and for regulating fertility. The other primary female sex hormone is progesterone. Secreted by the ovaries, its primary purpose is to enable gestation by triggering the lining of the endometrium to thicken. Androgens, although known primarily as male hormones, play a key role in women’s health. Converting into estrogens, androgens are catalysts for puberty in women and regulate the function of many organs.⁶ These androgens, produced in the ovaries and adrenal glands, may be responsible for “increasing libido, energy, bone mineral density, and muscle mass and strength,” although the full role of androgens in women is still being investigated.⁷

⁵ Amir and Biron-Shental, “The impact of hormonal fluctuations on female vocal folds,” 180.

⁶ "Androgen." *HealthyWomen*. <https://www.healthywomen.org/condition/androgen>.

⁷ Peter J. Snyder, “Editorial: The Role of Androgens in Women,” *The Journal of Clinical Endocrinology & Metabolism* 86, no. 3 (1 March 2001): 1006–1007.

Hormones and the Larynx

According to Cassiraga et. al, the “human larynx is considered to be a secondary sexual organ, and therefore it is under the influence of sexual hormones, being extremely sensitive to hormonal variations occurring during menstruation, menopause, and pregnancy.”⁸ Lã and Davidson reiterate that “during the life span [of an individual], the voice undergoes changes related to a person’s hormonal concentrations, and women are notably affected by these hormonal fluctuations more than men.”⁹ Over the course of a woman’s life, her vocal folds are directly subjected to the cyclical fluctuation of sexual hormones occurring each month. During the female cycle, the fluctuating levels of estrogen, progesterone, and testosterone can affect vocal quality and range. Many studies have been conducted in order to discover to what extent these hormones dictate the function of the larynx and whether or not it houses specific hormonal receptors. Although there is still some debate, most agree that the human larynx is considered a “hormonal target organ,”¹⁰ meaning that it is directly affected by changes in sexual hormones. Amir and Biron-Shental argue that “starting with the subjective reports on vocal changes associated with hormonal changes, through acoustic analysis of voice quality, to finding hormonal receptors in the larynx and in the vocal folds, it is clear that the larynx is affected by sex hormone fluctuations.”¹¹

⁸ Veronica L. Cassiraga, Andre V. Castellano, Jose Abasolo, Ester N. Abington, and Gustavo H. Izbizky, “Pregnancy and Voice: Changers during the Third Trimester,” *Journal of Voice* 26, no. 5 (September 2012): 584.

⁹ Fillipa Lã and Jane W. Davidson, “Investigating the Relationship Between Sexual Hormones and Female Western Classical Singing,” *Research Studies in Music Education* 24, no. 75 (2005): 7.

¹⁰ Ibid.

¹¹ Amir and Biron-Shental, “The impact of hormonal fluctuations on female vocal folds.”

These hormones, however, have other purposes preceding the childbearing years in a female's life. During the years preceding and during puberty, production of sexual hormones is responsible for both sexual maturation and vocal maturation of the larynx. According to Amir and Biron-Shental, the increased production of estrogen and progesterone are responsible for the gradual vocal changes in women, including slight increase in laryngeal size, lowered fundamental pitch, and increased amplitude and vocal tract size. It is important to note that these changes are more prominent in males due to the influx of testosterone.¹² As a woman continues into her primary reproductive years, hormonal fluctuations become more consistent through her monthly cycle.

Singers tend to be hyper-aware of changes occurring throughout the body, whether by means of internal or external forces, since their instruments are housed in and fueled by the body. As mentioned previously, sexual hormones can spark noticeable changes in the voice. Females in particular are subjected to regular vocal changes as a result of hormone fluctuation. According to Lã and Davidson, "prominent changes in the quality of the voice occur mostly when there are changes in the concentration of sexual hormones."¹³ The "cyclical changes in the mucosa of the vocal folds are similar to those occurring in the cervix of the uterus, since both tissues are physiologically and structurally similar."¹⁴ The cycle is divided into two phases: the follicular phase (the beginning of the menstrual cycle) and the luteal phase (the second half of the

¹² Amir and Biron-Shental, "The impact of hormonal fluctuations on female vocal folds."

¹³ Lã and Davidson, "Investigating the Relationship," 75.

¹⁴ Ibid. 81.

menstrual cycle). During a woman's monthly cycle, the follicular phase presents with increased estrogen and decreased progesterone, which causes swelling and increased blood flow in the vocal folds. Accompanying this hormonal recipe is an increase in polysaccharides (most notably hyaluronic acid), which are hydrophilic, or water-loving.¹⁵ The presence of polysaccharides facilitates increased bulk of the vocal folds. However, this bulk is low in viscosity (thinner, waterier tissue), which facilitates better vocal fold vibration and protection against collision forces. The net effect is a fuller sound to the voice with increased ease in phonation. Additionally, increased blood flow as a result of these polysaccharides can occur in the larynx and other mucosal linings of the vocal tract, including the nasal passages.¹⁶

In contrast, the luteal phase consists of an influx of progesterone "to a greater degree than estrogen level. Progesterone promotes sloughing of the laryngeal epithelium and works against proliferation [of bulk]. It also makes glandular secretions more viscous, leading to a decrease in vibratory efficiency and possibly increased cell damage."¹⁷ This fluctuation of hormones explains why many women have reported some difficulties with phonation just before the onset of menstruation (the latter part of the luteal phase).

There are two occurrences which eliminate this hormonal cycle: menopause and pregnancy. When the cycle is ended during menopause, the influx of androgens may cause a

¹⁵ Ingo Titze, *Principles of Voice Production* (Englewood Cliffs, N.J.: Prentice Hall, 1993).

¹⁶ Ibid.

¹⁷ Filipa Lã and Johan Sundberg. "Pregnancy and the Singing Voice: Reports From a Case Study," *Journal of Voice* 26, no. 4 (July 2012): 435.

“deepen[ing] of the voice and irreversible changes.”¹⁸ At the end of a woman’s childbearing years, her ovaries lose the ability to produce estrogen. The accompanying increase in polysaccharides causes mucosal degradation. This results in excessive dryness and atrophy of connective tissues. According to Amir and Biron-Shental, “normal voice production depends on the integrity of the connective layers [the makeup of water, collagen, elastin, and vessels as well as muscles] of the vocal folds.”¹⁹ When estrogen and progesterone decrease, and androgen levels escalate on the laryngeal layers, vocal changes are inevitable. Some complaints from professional singers include “loss of brilliance, loss of power, and decreased ability to reach high notes after menopause”²⁰ due to the loss of bulk and increased viscosity. Although these complaints were purely based on personal observations, a study of 100 menopausal women by Abitbol et al. found that “vocal folds were less supple, had a thinner mucosa, and had reduced vibratory amplitude.”²¹

In contrast, during pregnancy vocal effects may be experienced due the increase in hormone production. According to Hancock and Gross, “pregnancy involves major physiologic and atomic adaptations due to a dramatic increase in hormone levels... during pregnancy, there

¹⁸ Sameep Kadakia, Dave Carlson, and Robert T. Sataloff, “The Effect of Hormones on the Voice,” *Journal of Singing* 69, no. 5 (2013): 572.

¹⁹ Amir and Biron-Shental, “The Impact of Hormonal Fluctuations on Female Vocal Folds,” 182.

²⁰ Ibid.

²¹ Jean Abitbol, Patrick Abitbol, and Béatrice Abitbol, “Sex Hormones and the Female Voice,” *Journal of Voice* 13, no. 3 (September 1999): 433.

is a surge of estrogen and progesterone with loss of the periodic vocal changes typically associated with a menstrual cycle.”²²

Even though the cyclical vocal changes stop, the heightened influx of both progesterone and estrogen at different points during gestation can cause other issues. Among these issues are difficulties with phonation. Second in line after the importance of adequate breath energy, which will be discussed later, is the vibratory function of the vocal folds. Similar to the cyclical vocal effects experienced during menstruation, the surge of hormones during pregnancy may result in a variety of effects on the voice. For instance, the epithelial layer, the outermost layer of lubrication surrounding the vocal folds, usually allows the vocal folds to vibrate freely. As Dr. Paul E. Kwak, laryngologist at NYU’s voice center has put it, this layer “is full of blood vessels that can become engorged during pregnancy, causing the surface to thicken and grow sluggish.”²³ This may cause more difficulty in phonation and may result in changes in a female singer’s tone or an overall decrease in stamina and vocal aesthetic.

During pregnancy, nearly every layer of the vocal folds has potential for change as a result of these hormones, possibly inhibiting vocal production. The increased amount of estrogen causes a thickening of the laryngeal mucosa, causing the mucosa to become hyperemic (increased blood flow to the tissue) and edematous (accumulation of excess fluid).²⁴ These symptoms can result in “vocal fatigue, decreased upper range, loss of vocal power, and the loss

²² Kadakia et al., “The Effect of Hormones on the Voice,” 571.

²³ Catherine Saint Louis, “Singing While Pregnant,” *The New York Times*, February 23, 2017.

²⁴ Kadakia et al., “The Effect of Hormones on the Voice,” 585.

of some high harmonics, resulting in a metallic or huskier timbre.”²⁵ This can lead to an overall decrease in stamina and vocal aesthetic. More so, an influx of “estrogen increase[s] [epithelium] thickness [whereas] progesterone leads to changes in the intermediate layer, causing drying and increased tissue viscosity.”²⁶ This increased dryness and viscosity can result in decreased vocal agility, difficulties with phonation and vibration, and a decrease in hydration. This thickening of the mucosa may also cause an overall positive effect on the larynx, resulting “in greater vibratory amplitude and an improvement in sound timbre.”²⁷ According to research conducted by Vindhya Khare, because of estrogen,

There is a shedding of superficial cells of the vocal folds, which decreases the amount of laryngeal mucus; this can lead to a decreased need for throat clearing. The energy-storing lipid cells under the mucous membrane become stimulated, which makes the voice more supple. Estrogen also increases the oxygenation of the vocal folds and improves the permeability of blood vessels and capillaries in the vocal folds.²⁸

Progesterone affects the vocal folds in a different way. In contrast to estrogen, it actually has anti-proliferative effects on the mucosa, therefore “decreas[ing] glandular activity [causing] mucus secretions that become more thick and opaque.”²⁹ Progesterone also increases edema (swelling) by decreasing blood vessel permeability, while simultaneously decreasing smooth muscle stimulation. Whereas estrogen typically encourages more flexibility in the voice through increased permeability of blood vessels, progesterone “decreases and even inhibits capillary

²⁵ Stephanie Adrian, “The Impact of Pregnancy on the Singing Voice: A Case Study,” *Journal of Singing* 68, no. 3 (January/February 2012): 267.

²⁶ Filipe Martins Baptista Lã and Johan Sundberg. “Pregnancy and the Singing Voice: Reports From a Case Study. *Journal of Voice* 26, no. 4. (July 2012): 435.

²⁷ Vindhya Khare, "The Influence of Sex Hormones on the Female Singing Voice: A Review of the Literature, 1971-2016" (DMA diss., The University of Miami, 2016): 8.

²⁸ Ibid. 8.

²⁹ Amir and Biron-Shental, “The Impact of Hormonal Fluctuations on Female Vocal Folds.” 181.

permeability, thus trapping the extracellular fluid... causing tissue congestion.”³⁰ This is apparent in fluid retention throughout the body and in the vocal folds. In a seeming contradiction, progesterone can also cause vocal fold dryness due to the increased “viscosity and acidity level of the secretions of the glandular cells.”³¹

Although progesterone may seem like it only has negative impacts for the female singer, it helps maintain the health of the vocal folds when working alongside estrogen:

There is a continual fluctuating balance between estrogen and progesterone. When these two hormones are in balance, the outcome is a good distribution of fluid within the vocal folds. When these hormones are out of balance, there is asymmetry in vocal fold vibration, which causes irregularity in their oscillatory patterns. An oscillatory pattern is the wavelike pattern in which the vocal folds vibrate with a sustained motion over a period of time.³²

Similarly, this increased concentration of sex steroid hormones can increase water absorption, “leading to edema and as a consequence voice aperiodicity, lowering of fundamental frequency, and uncontrolled timbral changes.”³³ This has been reported more frequently in the third trimester, because of the particularly high concentration of estrogen and progesterone. Stephanie Adrian, who performed a case study during her own pregnancy, noted that although “there was no perceptible change in vocal fold appearance throughout [her pregnancy], at 35 weeks mild chasing asymmetry (out of sync mucosal wave) was noted in the high frequency sustained phonation.”³⁴ She commented that although her range was unaltered, she experienced

³⁰ Jean Abitbol, Patrick Abitbol, and Béatrice Abitbol, “Sex Hormones and the Female Voice,” *Journal of Voice*, 13, no. 3 (September 1999), 433.

³¹ *Ibid.*, 435.

³² Khare, “The Influence of Sex Hormones on the Female Singing Voice,” 8.

³³ *Ibid.*

³⁴ Adrian, “The Impact of Pregnancy on the Singing Voice,” 267.

increased effort in singing. The results from the survey presented later in this document will provide many other such anecdotes and further commentaries on women's experiences during pregnancy.

Although there are many other ways pregnancy affects the female body, the hormonal changes present the greatest likelihood of interfering with the singing voice. These changes include but are not limited to altered or shifted vocal range due to changes in bulk, increased fragility of the vocal fold blood vessels, increased propensity of acid reflux, and decreased nasal and sinus resonance due to rhinitis (inflammation of the nose or mucous membrane).³⁵ This can be particularly disheartening for professional voice users for whom even the most subtle vocal changes have a great effect. However, because “pregnancies are highly variable...there is no way to predict how a pregnancy will affect the voice.”³⁶

Mechanical and Postural Changes

The most prominently interrupted morphological change during pregnancy is body alignment. Increased hormones “loosen the joints, creating instability in alignment and balance”³⁷ while the body adjusts its center of gravity to counterbalance the baby's growth. “As the abdominal muscles stretch, the muscles in the lower back shorten and become tighter. The natural curves of the spine become even more S-shaped, and the body requires more muscular support to maintain good posture.”³⁸ This is why women may appear to walk slightly leaning

³⁵ Reena Gupta, “Pregnancy and the Voice,” *Osborne Head and Neck Institute*, Last modified 2016. . <http://www.ohniww.org/pregnancy-voice-change-problems/>.

³⁶ Adrian, “The Impact of Pregnancy on the Singing Voice,” 269.

³⁷ Adrian Pitman Will, “Pregnancy and Postpartum: A Guide for Singers” (DMA diss., Arizona State University, 2013), 14.

³⁸Ibid.

backwards during pregnancy—their musculoskeletal structure actually transforms slightly so that they do not fall forward as a result of the extra frontal weight of the baby. Additionally, as the baby continues to grow, further inhabiting the space in the abdominal area, the diaphragm is hindered from fully lowering. This may prevent women from fully expanding the lungs and thus inhaling a full breath.

Another mechanical change commonly experienced during pregnancy is GERD (gastroesophageal reflux disorder). Increased pressure on the lower esophageal sphincter created by the growing fetus in the abdominal cavity can cause the closing of the stomach to become weak or even to remain open, leaving little barrier between the contents of the stomach and the esophagus. “The elevation of the female sex hormone progesterone and a decrease in lower esophageal sphincter pressure”³⁹ exacerbates the development of GERD during pregnancy. Otolaryngologist Dr. Reena Gupta explains this further, stating that this influx of hormones causes “relaxation of the sphincter that keeps food in your stomach (and normally prevents it from coming up into your larynx). Also, your stomach capacity is less; when it gets full (which happens quicker than normal), you’re more likely to regurgitate acid.”⁴⁰

Mechanical Changes of the Voice

Apart from hormonal changes, other changes in the vocal mechanism can occur due to the changing body morphology during pregnancy. This disrupts the natural singing posture: efficient vocal production is compromised because the diaphragm cannot fully lower, and thus

³⁹ Adrian, “The Impact of Pregnancy on the Singing Voice,” 269.

⁴⁰ Gupta, “Pregnancy and the Voice.”

the lungs cannot fully expand. In addition, changing the center of gravity may tax abdominal muscles, causing them to become more tense and less responsive to the subtle demands of breath control, because they are acting more like postural muscles. According to Clifton Ware, “correct alignment of the body is extremely important in setting up the right conditions for coordinating the vocal process.”⁴¹ Due to the curvature of the spine causing an inability to inhale fully, women may be tempted to resort to under-supported singing, shallow breathing, or they may compensate with excess tension elsewhere in the body, such as the neck. Because proper alignment is crucial to maintain the coordination of breathing muscles involved in singing, it is important for female singers to be aware of these changes as to not overcompensate elsewhere.

The element of singing most strongly impacted by mechanical changes during pregnancy is the breathing mechanism. The breath provides the motor and energy behind all sound production. This is particularly crucial when dealing with singers, as breath management for vocalists is essential. Singers spend years mastering proper breath support in order to give them the most efficient means of singing. During pregnancy, a woman must, in a sense, re-learn to breathe. According to Pittman Will,

As the fetus grows, both inhalation and exhalation are directly affected by the growth of the uterus. Since the uterus is located underneath the diaphragm, it is therefore subject to the inspirational forces of the diaphragm. For the singer, the more concerning aspect would be the reverse: the inspirational force of the diaphragm is subject to the size of the uterus...[therefore], breathing difficulty during pregnancy [can be] attributed to the descent of the diaphragm being directly limited by the growing size of the uterus...research shows that the fundamental level of the diaphragm actually rises in the chest cavity by four centimeters as the pregnancy progresses.⁴²

⁴¹ Clifton Ware, “Body-Mind Integration,” *Basics of Vocal Pedagogy*, 49.

⁴² Will, “Pregnancy and Postpartum: A Guide for Singers,” 14.

Because the body is making room for the growing uterus, women have reported an increased level of difficulty in breathing, especially during the third trimester. While a normal, healthy singer would aim to breathe low breaths into the abdomen, back, and sides while expanding through the intercostal muscles, this is directly impeded by the presence of the fetus. During pregnancy, breathing becomes more active in the intercostals, as the baby inhibits lower breathing. For women who have dominant diaphragmatic breathing, as singers do, breathing may feel more clavicular during the latter stages of pregnancy. This breath limitation may also limit maximum phonation time. As a result, women may find breathing more laborious and singing long phrases more difficult.⁴³

According to voice instructor Karyn O'Connor, this may be partially dependent on how the woman is carrying the baby. In the case of a woman "carrying high," women may resort to "thoracic (chest) breathing because the size and height of the womb and [the] unborn baby [make] it difficult, if not impossible, to allow for free movement of the diaphragm and expansion of the lungs and abdomen."⁴⁴ On the other hand, a woman who is "carrying low" "may find that she is able to continue employing diaphragmatic breathing or *appoggio* technique throughout her pregnancy,"⁴⁵ noticing little to no change in breathing. These women may even find that the fetus supports proper *appoggio*.

Whether pregnancy results in positive or negative changes to one's breathing, it is crucial that the singer does not compensate with bad technique or excess tension. Pregnant or not, this is

⁴³ Cassiraga, Veronica L., et al., "Pregnancy and Voice: Changes during the Third Trimester," *Journal of Voice* 26, no. 5 (September 2012): 585.

⁴⁴ O'Connor, Karyn. "Singing While Pregnant." Singwise. 2018. Accessed February 13, 2019. <http://www.singwise.com/cgi-bin/main.pl?section=articles&doc=SingingWhilePregnant>.

⁴⁵ Ibid.

very frequently seen in young singers who have not yet developed proper *appoggio* to produce the right amount of breath energy to sustain a full, clear tone. When breath support is not present, something else must sustain the voice. The same is true during pregnancy when the breath energy is inadvertently hindered. Although “the voice might sound ‘heavier’ and feel more difficult to ‘support,’ singers should be careful not to try and compensate for this by using secondary muscles of the neck, head, throat, jaw or tongue.”⁴⁶

According to Johnson, “acid reflux, a common plague in pregnancy, can also make singing painful, because stomach acid can travel up and irritate the throat and drip down onto the [larynx]. ‘It’s like having heartburn in your throat,’ Dr. Johnson said. ‘The tissue is raw, possibly swollen, making it more difficult to get the voice out.’”⁴⁷ Symptoms of GERD include heartburn, nausea, regurgitation, throat clearing, post-nasal drip, and alterations to the voice. For obvious reasons, this can be very troublesome for a professional singer, especially if the excess acid comes in contact with the larynx. Regurgitation in particular can cause a number of problems for singers. Some include, but are not limited to, swelling and soreness of the throat, difficulty and pain during swallowing, edema in the vocal folds, and laryngitis.

Another frequent complaint during pregnancy is rhinitis, or the swelling of the nasal passages and overproduction of nasal congestion lasting six or more weeks during pregnancy. Most frequently, pregnancy rhinitis affects women early in the first trimester and again later in the pregnancy. Rhinitis may be caused by allergies or the hormonal increases leading to edema and increased blood flow to the nasal passages. Although rhinitis does not directly affect the voice, it may cause breathing difficulties due to decreased oxygen intake and forced mouth

⁴⁶ Lã and Sundberg, “Pregnancy and the Singing Voice,” 431.

⁴⁷Catherine Saint Louis, "Singing While Pregnant."

breathing. Because nasal breathing warms, humidifies, and filters the air we breathe, mouth breathing, an inefficient inspiratory technique, causes undue dryness and irritation of the vocal tract and larynx. This in turn can affect phonation.⁴⁸ Additionally, swelling in the tissues of the vocal tract and nasal passages changes the normal sensation a singer relies on for tactile and proprioceptive feedback during singing, which may cause unintended changes in technique.

⁴⁸Chaunie Brusie, "Natural Ways to Clear up Rhinitis of Pregnancy," Healthline, April 7, 2016, <https://www.healthline.com/health/pregnancy/rhinitis#2>.

PART 2: SURVEY METHODOLOGIES

Purpose of the Study

In researching this topic, a gap in research on the effects of pregnancy on the voice was found. Although many have researched and written on hormonal effects on the voice through puberty, menstruation, and menopause, very little has been specifically written about pregnancy. What has been written is generally theoretical and lends itself to scientific findings indiscernible to the average person. The aim of this project was to determine current practices in educating singers about pregnancy and what to expect about voice use and singing. From this information, a clearer understanding may be gained of what still needs to be researched and what types of educational information would be helpful to pregnant singers. Alongside a review of current literature on the subject, a large part of the research for this document was gathered by creating a survey to distribute among current singing women who have been pregnant. The purpose of the survey was to gain information through self-reporting from women who sang during their pregnancies on what they were told about the effects of pregnancy on the voice compared to what they actually experienced. From the information gathered, a current state of affairs of pregnant singers was obtained to establish clearer lines of future research and appropriate educational methods.

Research Design

The survey is a cross-sectional design of a population of singers who were pregnant at one time in their lives with the purpose of determining what female singers were told about the possible effects of pregnancy on the voice as compared to what they experienced. The research

proposal was submitted to the Institutional Review Board (IRB) at the University of Memphis and was granted an exempt approval on February 11, 2019 under protocol number PRO-FY2019-401.

Participants

Participants were 321 females who identified themselves as singers through an anonymous survey distributed through social media groups. Social media groups included voice organizations such as the National Association of Teachers of Singing, the Facebook groups Shoperatic and The New Forum for Professional Voice Teachers, and through direct distribution of the anonymous survey link. The survey was available from February 12, 2019 to March 5, 2019.

Procedures

Once participants learned about the survey and agreed to participate, they signed an electronic consent form explaining potential risks of participation in the study. Participants then completed an original survey examining general pregnancy information, demographics, health-seeking information, and experiences while pregnant. This survey also included places for optional, additional comments. No compensation was provided.

Instrumentation and collection

Survey Format:

Data collection via an original survey was available through Qualtrics.com where an anonymous survey link became available to participants. Survey questions included information

women were told about pregnancy and the voice versus what they experienced; positive and negative changes to breathing, phonation, resonance, range, and stamina; performance adaptations; practice and technique adaptations; how late in pregnancy they were able to comfortably perform; and whether any of the changes remain in the early weeks of postpartum. The complete survey can be found in the Appendix.

Survey Outline:

General Pregnancy Information: This section guided participants through questions regarding their pregnancy, including how many pregnancies carried passed the first trimester, age(s) during each pregnancy, active vocal study or performing while pregnant, type of delivery, any hormonal fertility treatments, and any other complications during pregnancy unrelated to the voice.

Demographics: This section contained questions regarding the style of music which the participant primarily sings, the vocational or volunteer singing activities in which she participates, and the highest level of formal education and vocal training.

Health information: This section asked the participant to write about the information gathered or offered to her about the effects of pregnancy on the voice and from where she received this information.

Experience while pregnant: This section was formatted similarly to the previous section but focuses on what the participant actually experienced during pregnancy regardless of what she was told.

Additional questions and comments: This section contained open-ended questions allowing for any additional comments participants wanted to share.

Variables for Analysis

In order to collect data on what women were told about the effects of pregnancy on the voice versus what women actually experienced, questions were designed in a parallel fashion to net the most accurate results. Questions from the “Health Information” and “Experience While Pregnant” sections were compared to each other. Results fell into one of four categories: 1. information gathered matched experience, 2. information gathered was not experienced, 3. experiences were not provided in information, and 4. some information matched experience. Results from the changes to breathing, phonation/resonance, range, stamina, performance adaptations, practice and technique adaptations, and performance longevity through the pregnancy were analyzed in these four categories separately.

Open-ended statements were coded for each topic area: breathing, phonation/resonance, range, stamina, performance adaptations, practice and technique adaptations, and performance longevity. If open-ended statements suggested that the participants were told or personally experienced what they wrote, these statements were included in the analysis.

Additional variables for analysis included the most commonly stated advice provided to singers and the most common experience reported by the singers. Other open-ended statements were coded for changes experienced after pregnancy, what participants wish they had known prior to pregnancy, and any additional comments they wished to share.

PART 3: RESULTS

Information from the “General Pregnancy Information,” “Demographics,” “Health Seeking Information” and “Effects Experienced During Pregnancy” sections were calculated using simple statistics (calculations of percentage). Of the 321 total participants, 185 women completed the survey. The remaining 136 participants were removed from the following data because they failed to answer questions beyond demographic information. For examples of spontaneous responses, please see Part 4.

Demographics

Of the 185 participants who completed this section, 55% (102) reported that their primary singing role is that of a solo singer, 11% (20) reported choral singer, 4% (8) reported primary music educator, 5% (9) reported secondary music educators, 9% (16) reported higher music educator and 16% (29) reported private voice teachers. See **Figure 1.1** for a graphical display.

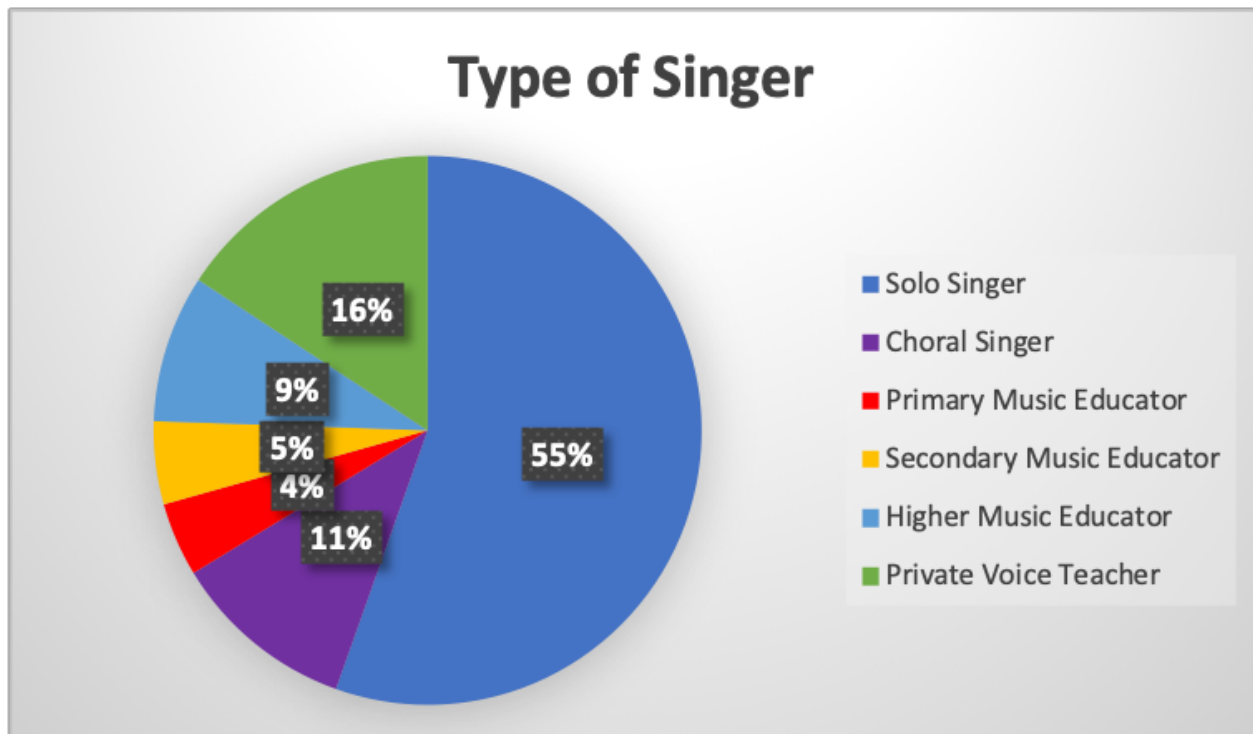


Figure 1.1

Participants were asked to select the styles of music in which they primarily sing. Of the given options, they were asked to select all that apply, so results display a sum greater than that of the 185 total participants. Of the 685 given answers, 19% (127) reported that they primarily sing in genres including opera, 20% (137) sing art song, 16% (110) sing oratorio, 13% (90) sing musical theater, 17% (117) sing sacred or church music, 3% (22) sing jazz, 3% (18) sing folk or country, 1% (8) sing gospel, 5% (32) sing popular or commercial music, 2% (14) sing rock & roll, and 1% (10) others reported other styles including ethnic (Eastern European folk music specifically), rhythm and blues, soul, early music, worship music, early childhood educational songs, original music compositions. See **Figure 1.2** for a graphical display.

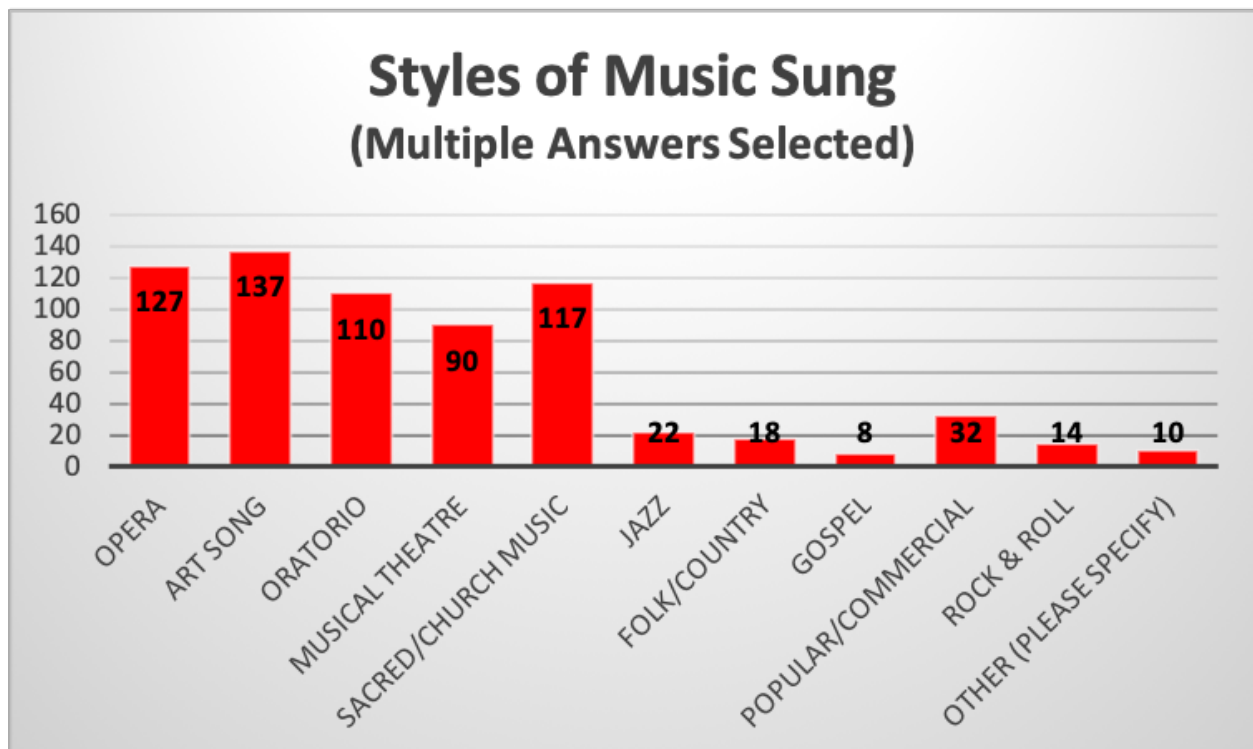


Figure 1.2

Of the 185 participants who completed this section, 51% (95) reported their highest earned degree was a master's degree, 28% (51) reported they received a bachelor's degree, 15% (28) reported that they received a doctoral degree, 4% (7) reported they received an artist

diploma, 2% (3) reported they received an associate’s degree and 0% (0) reported they received a high school diploma as their highest degree earned. See **Figure 1.3** for a graphical display.

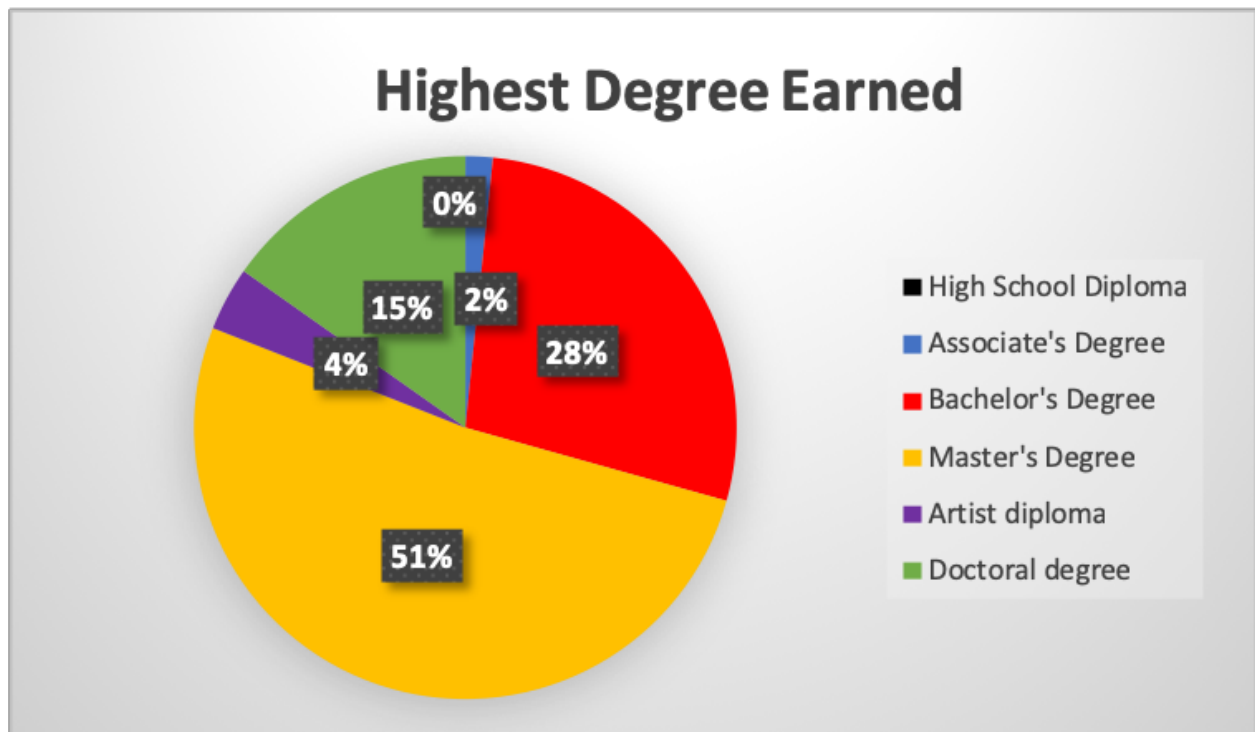


Figure 1.3

Of the 189 participants who completed this section, 47% (86) reported that their highest level of vocal training was training at the master’s level, 26% (47) reported training at the bachelor’s level, 17% (32) reported training at the doctoral level, 4% (8) reported private voice lessons, 3% (5) reported training for an artist’s diploma, 1% (2) reported training at the associate’s level, 1% (2) reported high school vocal experience, and 1% (2) reported no formal vocal training. See **Figure 1.4** for a graphical display.

Participants were asked to select the ages at which they were pregnant. Of the given options, they were asked to select all that apply, so results display a sum greater than that of the 185 total participants. Of the given answers, 39% (103) reported pregnancies between the ages of 30 and 35, 27% (72) reported pregnancies between the ages of 25 and 30, 19% (50) reported

pregnancies between the ages of 35 and 40, 11% (28) reported pregnancies between the ages of 18-25, and 4% (10) reported pregnancies over age 40. See Figure 1.5 for a graphical display.

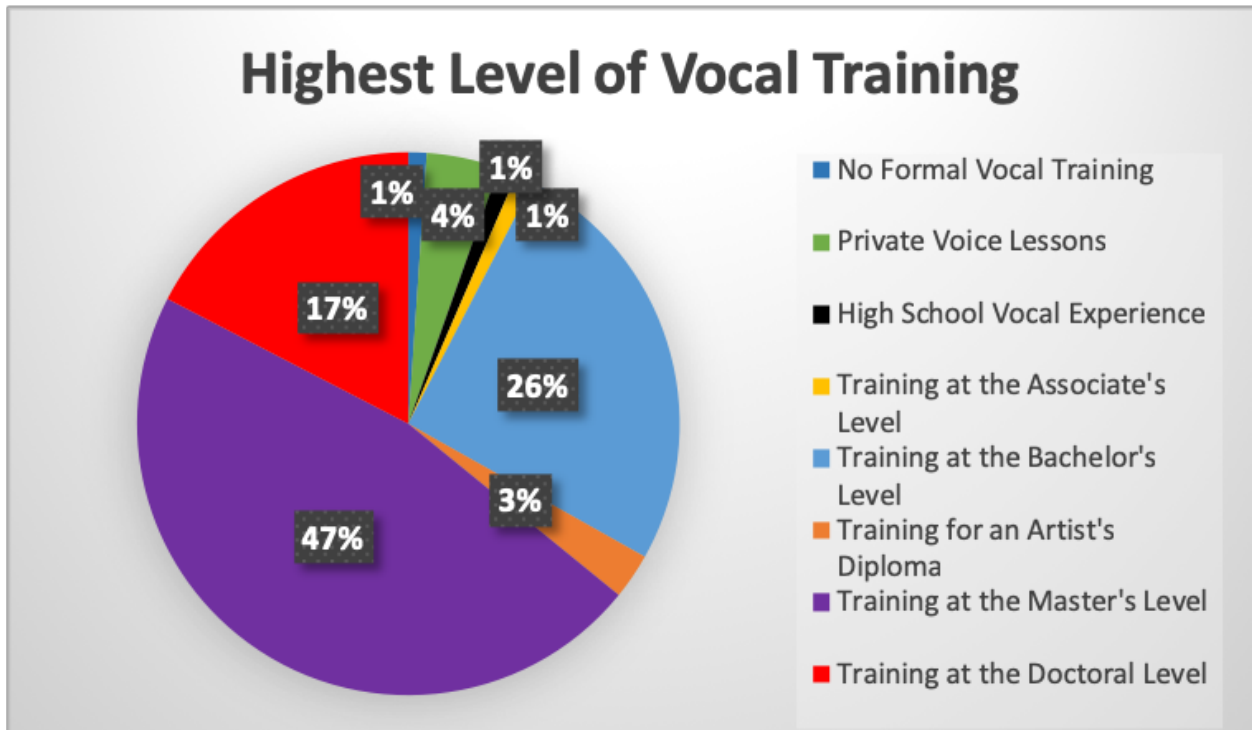


Figure 1.4

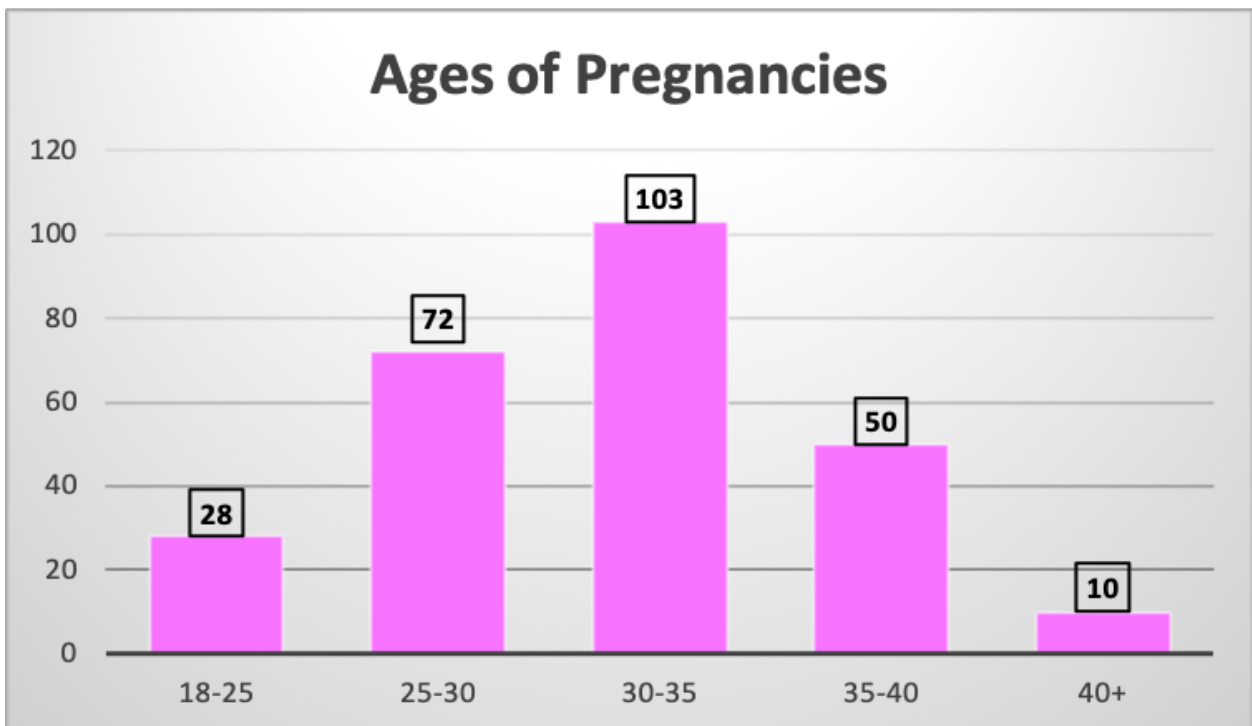


Figure 1.5

Of the pregnancies reported, women were asked to report how many of those were carried past the first trimester. Of the reported pregnancies, 89 reported they carried one pregnancy past the first trimester, 66 reported they carried two pregnancies past the first trimester, 21 reported they carried three past the first trimester, 8 reported they carried 4 pregnancies past the first trimester and 1 reported they carried 5 or more pregnancies past the first trimester. Of the pregnancies reported, 37 of them were reported to be delivered by Cesarean section. See **Figure 1.6** for a graphical display.

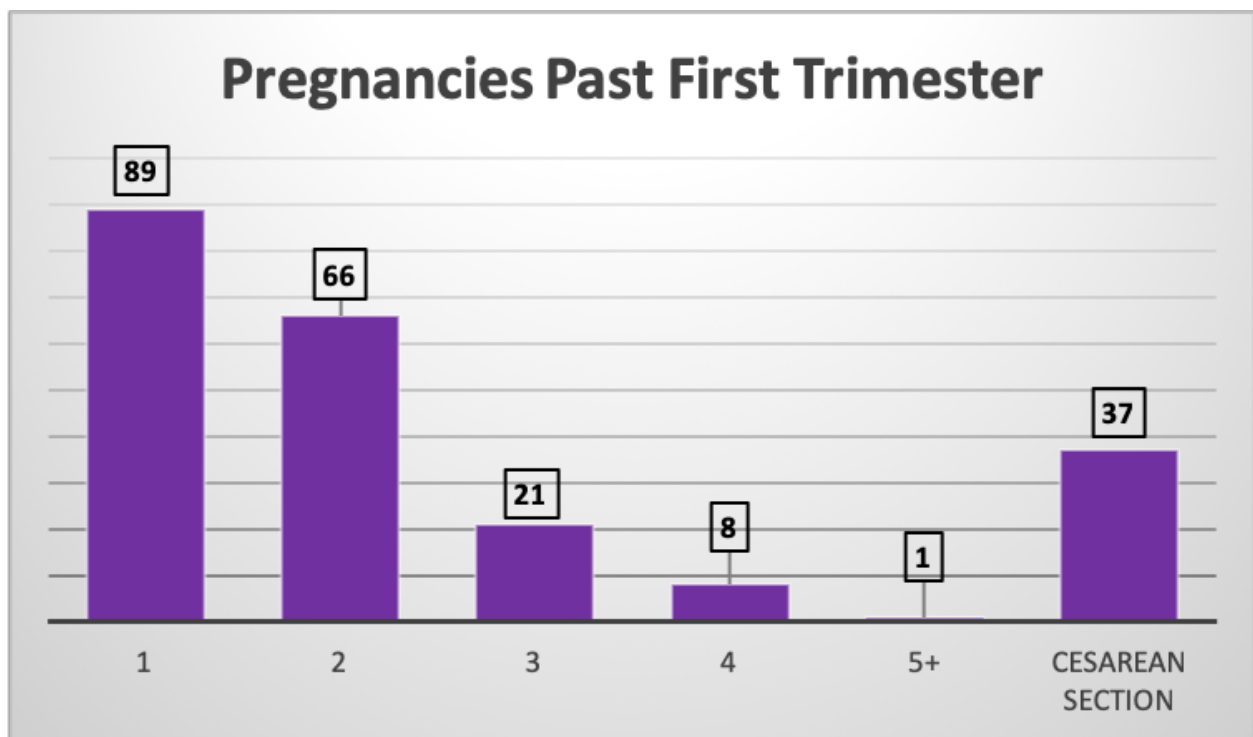


Figure 1.6

Of the 185 participants who completed this section, 90% (166) reported they were actively performing while pregnant, 5% (10) were not actively performing while pregnant, and 5% (9) reported other (including demonstration for students, occasional performances, originally planned performances were canceled). See **Figure 1.7** for a graphical display.

Of the 185 participants who completed this section, 61% (112) reported they were a studying music while pregnant, 27% (50) were not studying music while pregnant, and 12% (23)

reported other (many reported that they were studying for performances but not in school or maintaining a regular teaching or performing schedule). See **Figure 1.8** for a graphical display.

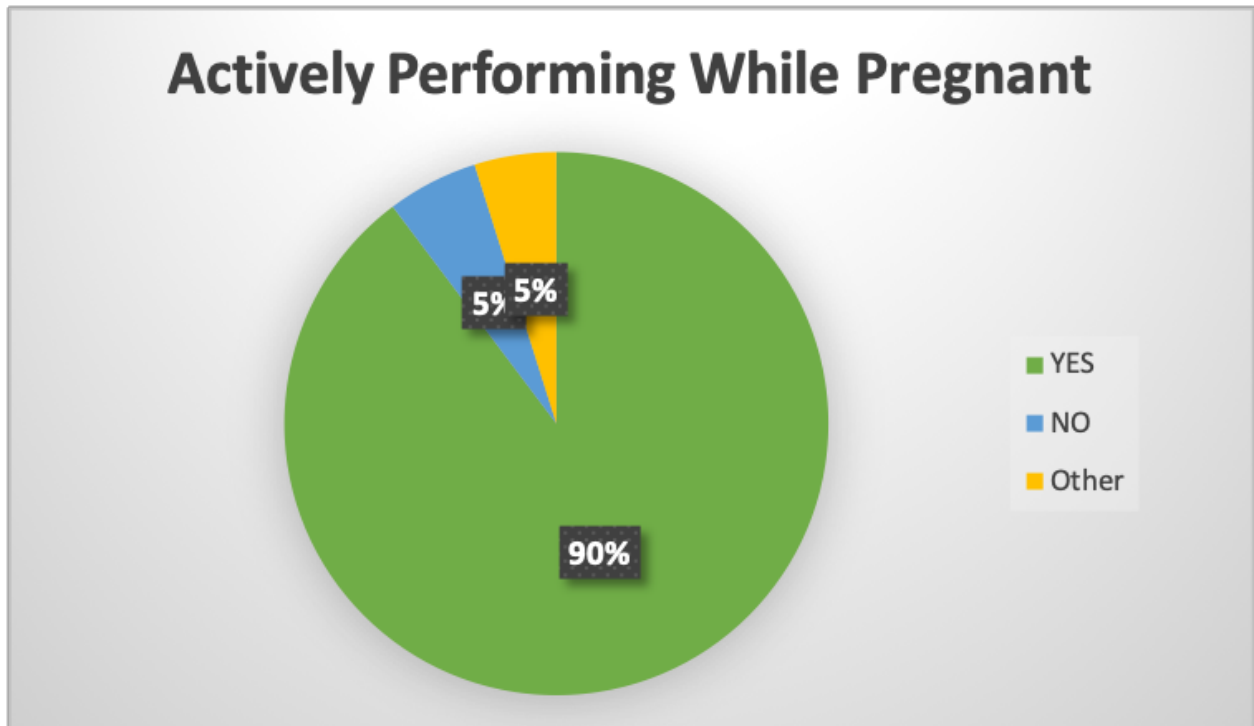


Figure 1.7

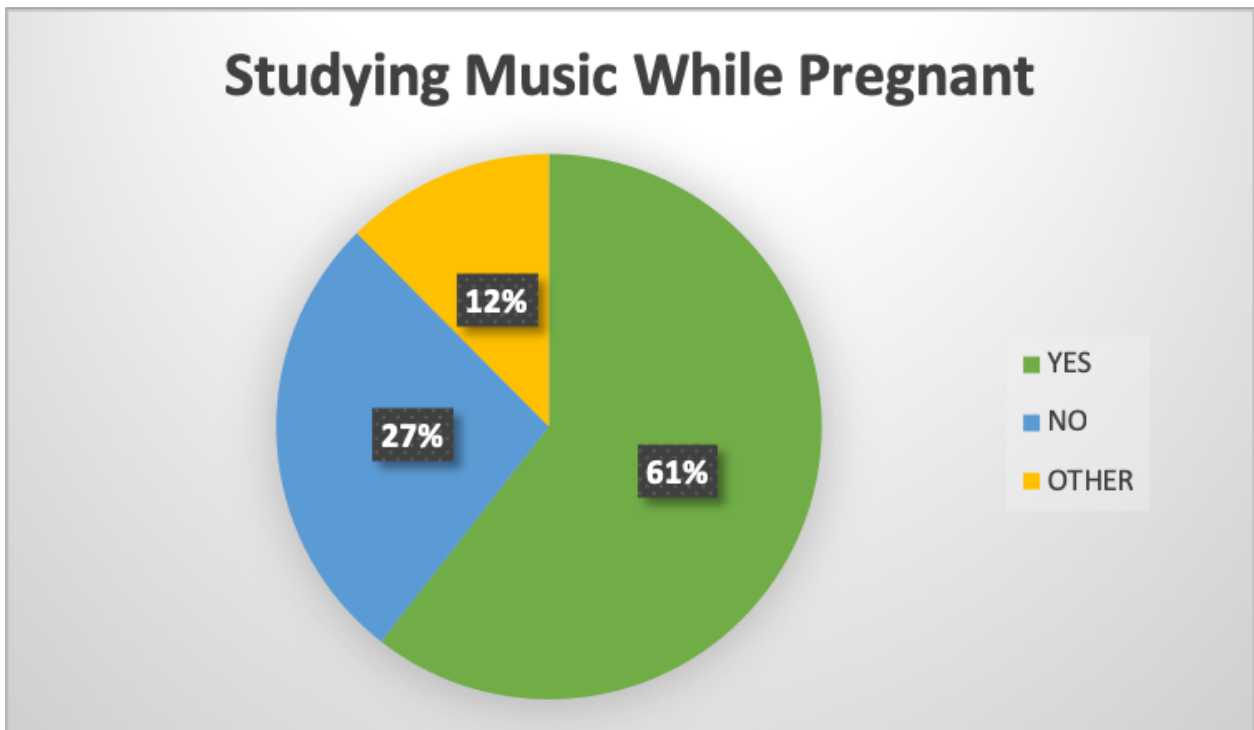


Figure 1.8

Of the 184 people who completed this section, 20% (38) reported that they received information about possible effects of pregnancy on the voice and 80% (146) reported that they did not receive information. 43% reported that they personally sought out information about possible effects of pregnancy on the voice and 57% (104) did not seek out information. See **Figure 1.9** for a graphical display.

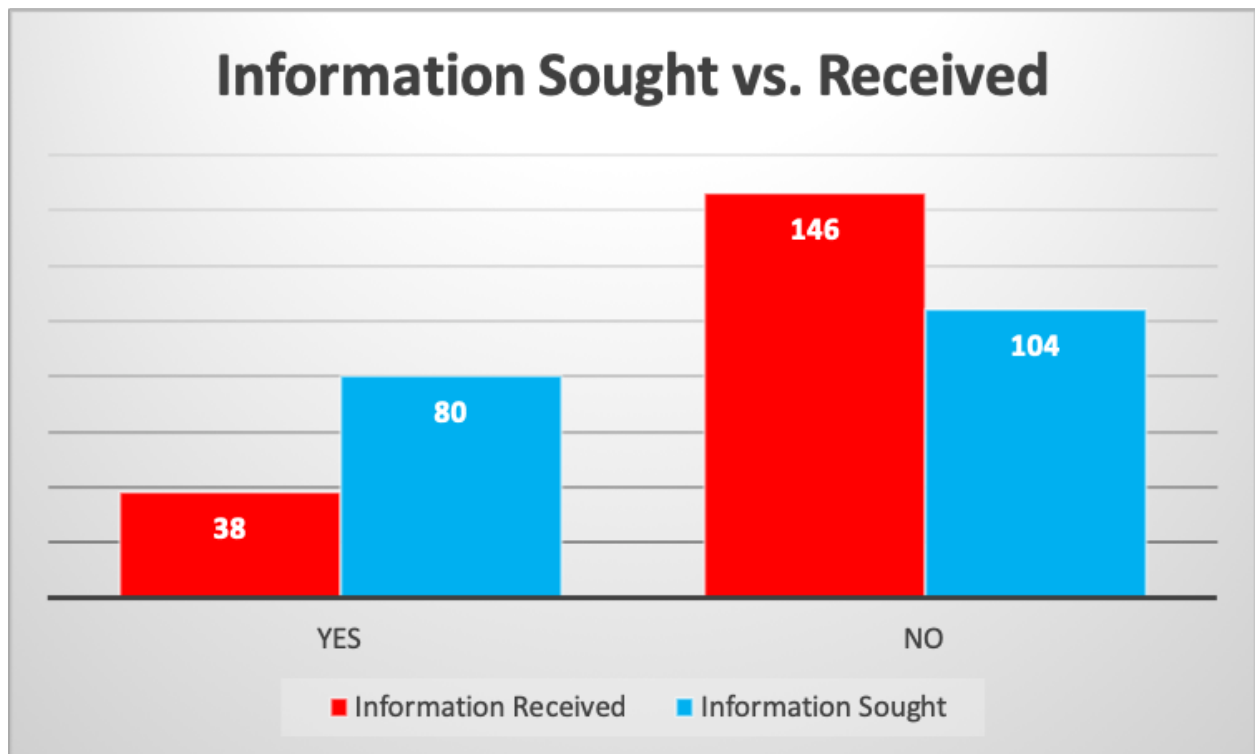


Figure 1.9

Breathing

Participants were asked about information they received regarding possible effects of pregnancy on breathing, from whom they received the information, what they experienced during pregnancy and how that compared with the information received. They were asked to select all that apply, so results display a sum greater than that of the 185 total participants. Of the 857 total responses, 43% (364) of reported they received information about possible breathing

changes during pregnancy and 57% (493) reported that they did not receive any information. Of the information received, 15% (126) reported they received information from their friend or colleague, 11% (94) received information from their teacher, 8% (68) received information from the internet, 3% (25) received information from books, 3% (26) received information from their physician, 2% (14) received information from their director, 1% (8) received information from another unlisted source, and 0% (0) received information from their agent. See **Figure 2.1** for a graphical display.

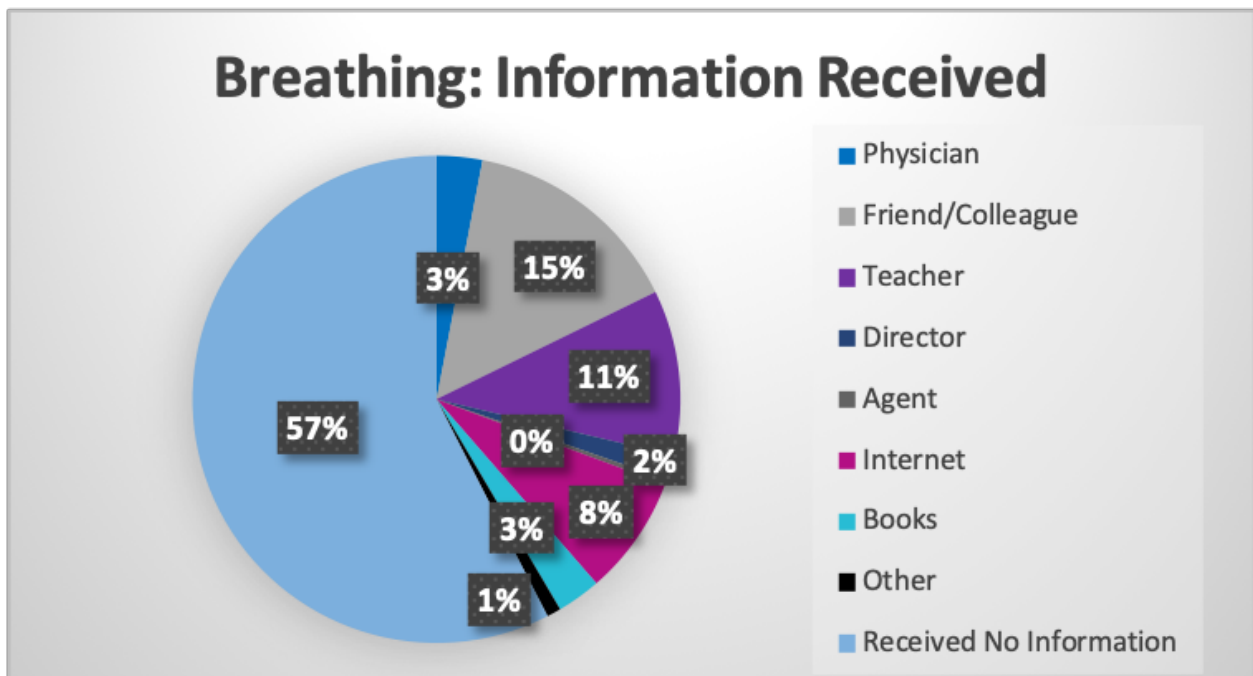


Figure 2.1

Of the 368 total responses, the most commonly reported breathing change was difficulty sustaining long phrases during pregnancy with 29% (108), second most commonly reported was difficulty getting a full breath at 28% (104), third most commonly reported was ease of breathing in singing at 11% (41), next most commonly reported was difficulty controlling exhalation at 10% (35), next was no noticeable changes in breathing in singing during pregnancy at 9% (32),

followed by sensations of breathing in the chest at 5% (20), and lastly sensations of breathing in the back at 8% (28). See **Figure 2.2** for a graphical display.

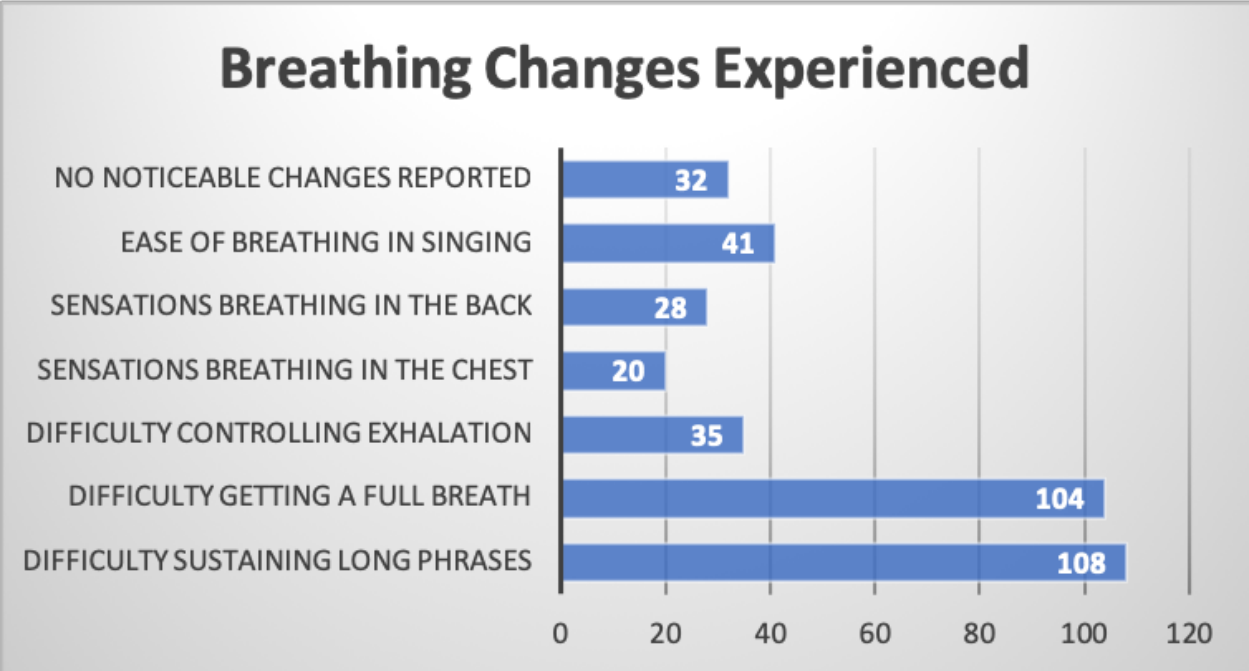


Figure 2.2

Of the 185 people that completed this section, 11% (20) reported that they began noticing changes to their breathing in the first trimester, 33% (61) reported they noticed in the second trimester, 39% (73) reported they noticed in the third trimester, and 17% (31) did not specify. See **Figure 2.3** for graphical analysis.

To answer the question about what women were told about the effects of pregnancy on the voice versus what they experienced, **Figure 2.4** shows that 42% received some information that matched some of their experience, 21% received information that matched their experience, 17% received information but did not experience what they were told, 10% experienced changes but had not received information prior to experience, and 10% of responses were inconclusive from a lack of data.

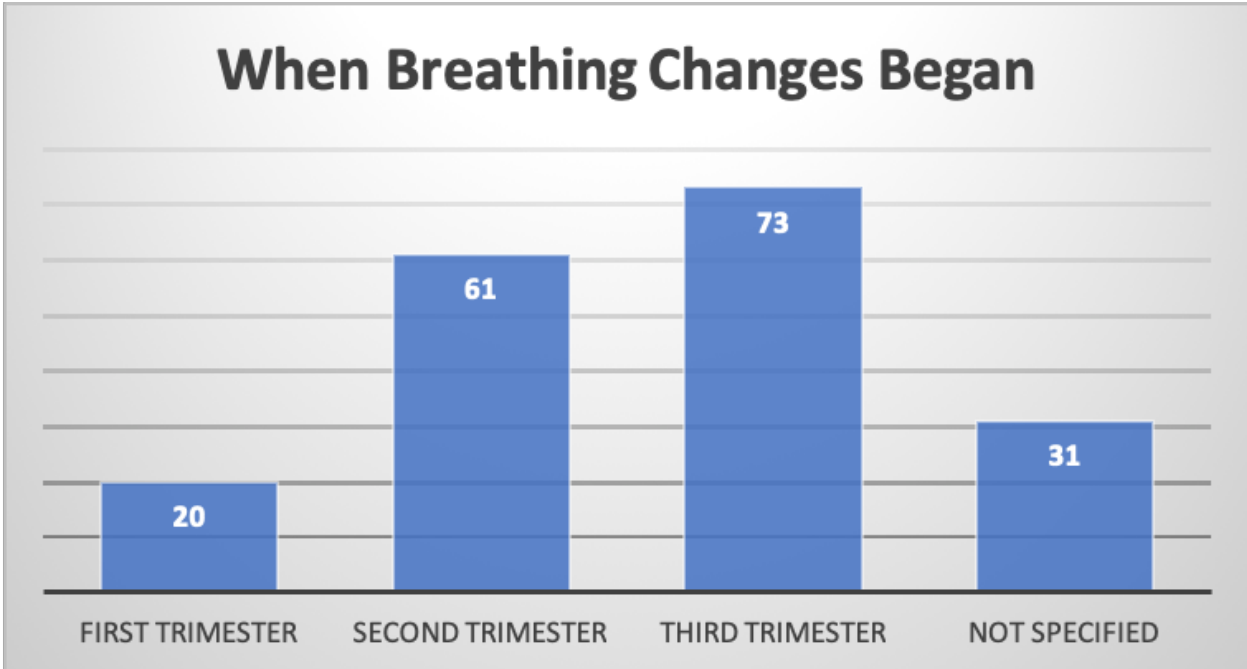


Figure 2.3

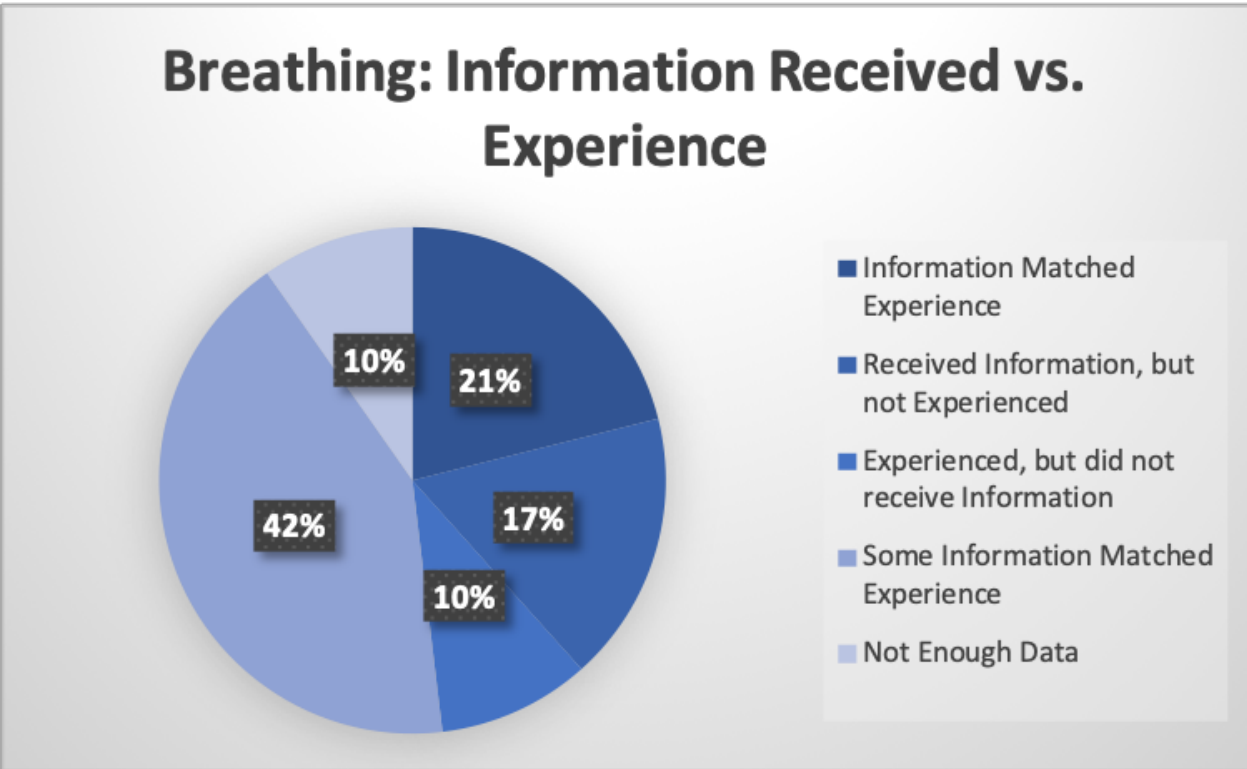


Figure 2.4

Phonation

Participants were asked about information they received regarding possible effects of pregnancy on phonation, from whom they received the information, what they experienced during pregnancy and how that compared with the information received. They were asked to select all that apply, so results display a sum greater than that of the 185 total participants. Of the 1,144 total responses, 20% (229) of reported they received information about possible phonation changes during pregnancy and 80% (915) reported that they did not receive any information. Of the information received, 7% (83) reported they received information from their friend or colleague, 7% (75) received information from their teacher, 4% (42) received information from the internet, 1% (14) received information from books, 0% (3) received information from their physician, 1% (10) received information from their director, 0% (2) received information from another unlisted source, and 0% (0) received information from their agent. See **Figure 3.1** for a graphical display.

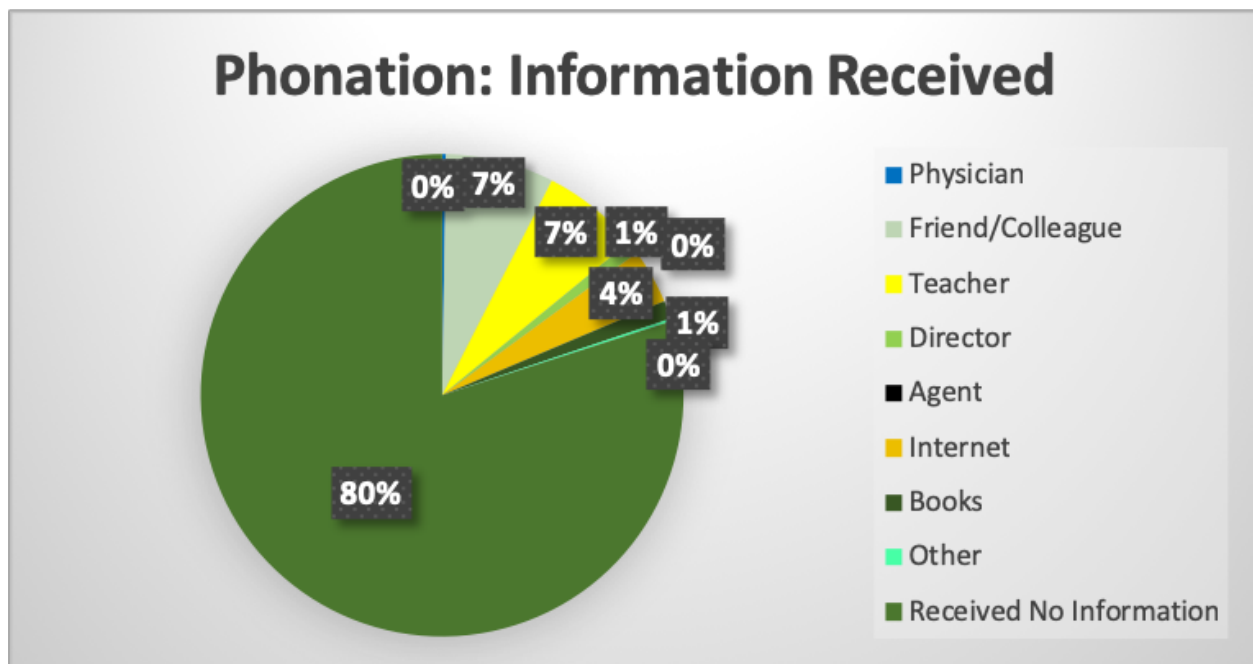


Figure 3.1

Of the 308 total responses, the most commonly reported phonation experience was no noticeable changes reported at 21% (62). The most commonly reported phonation change experienced was downward shift in vocal range at 14% (42), second most commonly reported were both difficulty singing with agility and coloratura at 13% (41) and difficulty singing in the upper register at 13% (41). The third most commonly reported was difficulty singing with legato/sustained singing at 12% (38) followed by difficulty singing in an around the *passaggi* at 9% (28). Next most commonly reported was upward shift in vocal range at 6% (17), then difficulty singing under mezzo piano at 5% (16). Lastly, difficulty singing in the lower range was reported at 4% (13) followed by difficulty singing over mezzo forte at 3% (10). See Figure 3.2 for a graphical display.

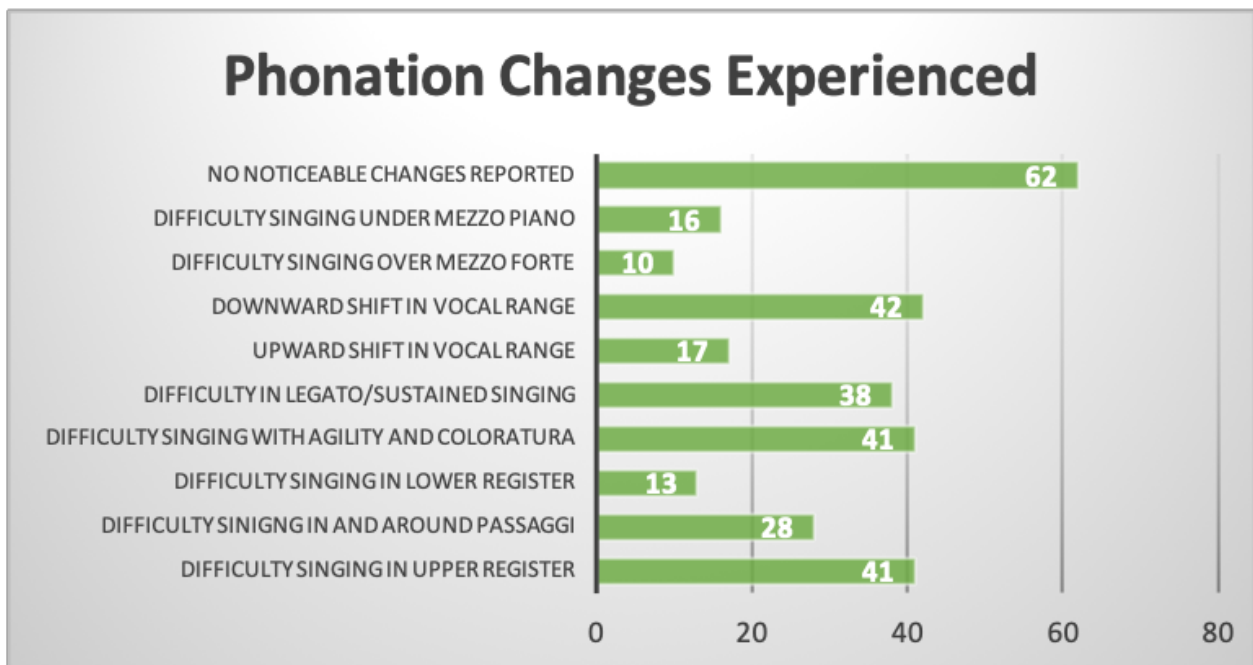


Figure 3.2

Of the 184 people who completed this section, 10% (19) reported that they began noticing changes to their breathing in the first trimester, 30% (56) reported they noticed in the

second trimester, 20% (37) reported they noticed in the third trimester, and 40% (72) did not specify. See **Figure 3.3** for graphical analysis.

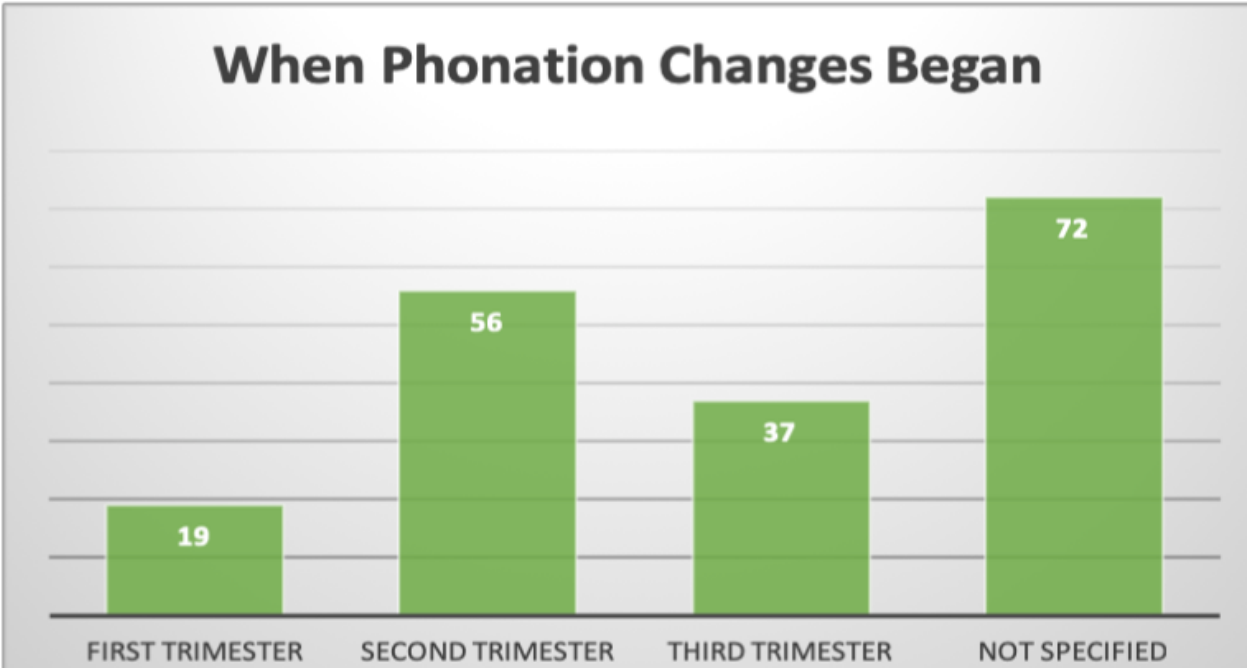


Figure 3.3

To answer the question about what women were told about the effects of pregnancy on the singing phonation versus what they experienced, **Figure 3.4** shows that 39% received some information that matched some of their experience, 14% received information that matched their experience, 23% received information but did not experience what they were told, 11% experienced changes but had not received information prior to experience, and 13% were inconclusive from a lack of data.

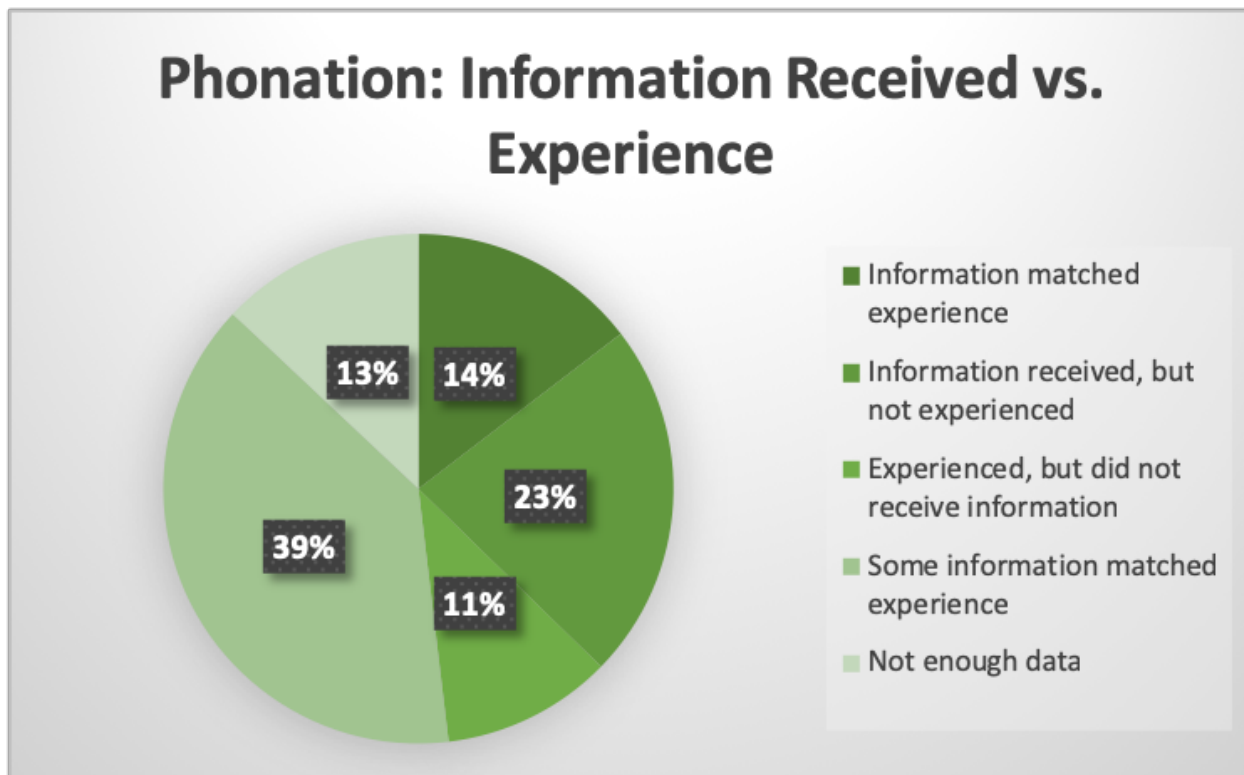


Figure 3.4

Vocal Quality

Participants were asked about information they received regarding possible effects of pregnancy on vocal quality, from whom they received the information, what they experienced during pregnancy and how that compared with the information received. They were asked to select all that apply, so results display a sum greater than that of the 185 total participants. Of the 1,214 total responses, 20% (247) of reported they received information about possible vocal quality changes during pregnancy and 80% (967) reported that they did not receive any information. Of the information received, 7% (88) reported they received information from their friend or colleague, 6% (74) received information from their teacher, 3% (39) received information from the internet, 1% (16) received information from books, 1% (9) received information from their physician, 1% (8) received information from their director, 1% (12)

received information from another unlisted source, and 0% (1) received information from their agent. See **Figure 4.1** for a graphical display.

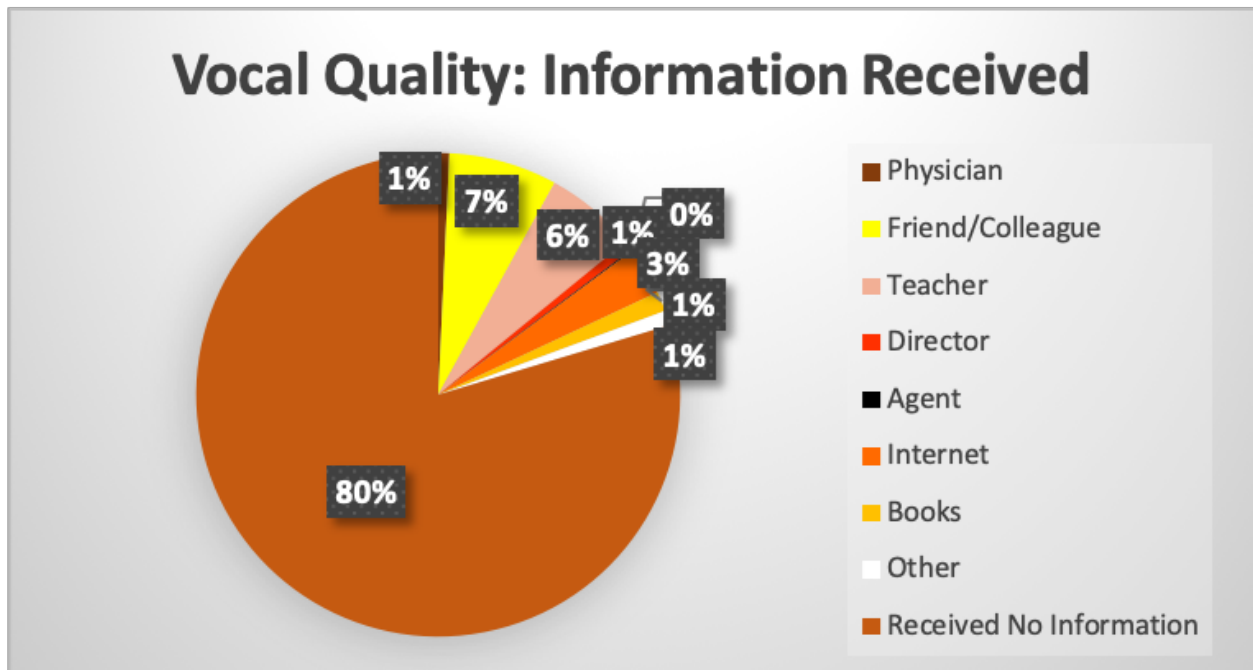


Figure 4.1

Of the 264 total responses, the most commonly reported vocal quality change experienced during pregnancy was a darker/warmer vocal timbre at 31% (82). The second most commonly reported vocal quality change was a fuller/heavier timbre at 20% (52). The third most commonly reported was hoarseness at 11% (30) followed by breathiness at 9% (25). The next most commonly reported were difficulty producing a clear tone at 8% (20) followed by brassy/stringent tone quality at 2% (6) and a brighter vocal timbre at 2% (5). 17% (46) reported no noticeable changes to vocal quality during pregnancy. See Figure 2.2 for a graphical display.

Of the 180 people who completed this section, 10% (17) reported that they began noticing changes to their breathing in the first trimester, 38% (69) reported they noticed in the second trimester, 20% (36) reported they noticed in the third trimester, and 32% (58) did not specify. See **Figure 4.3** for graphical analysis.

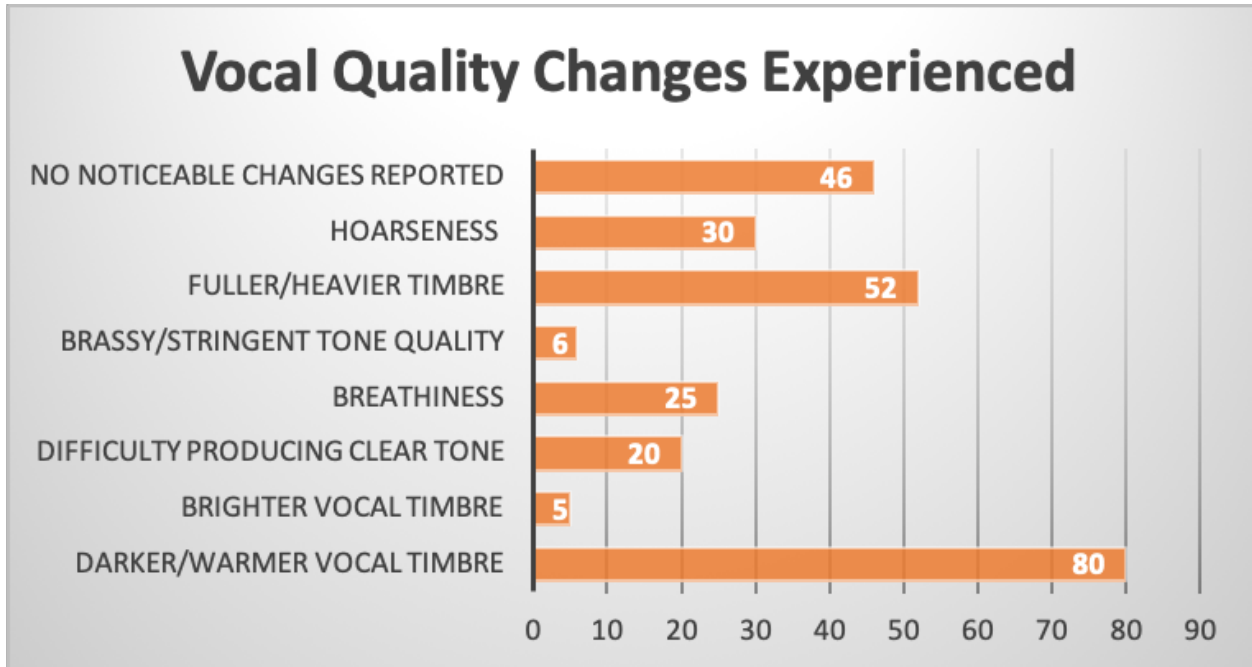


Figure 4.2

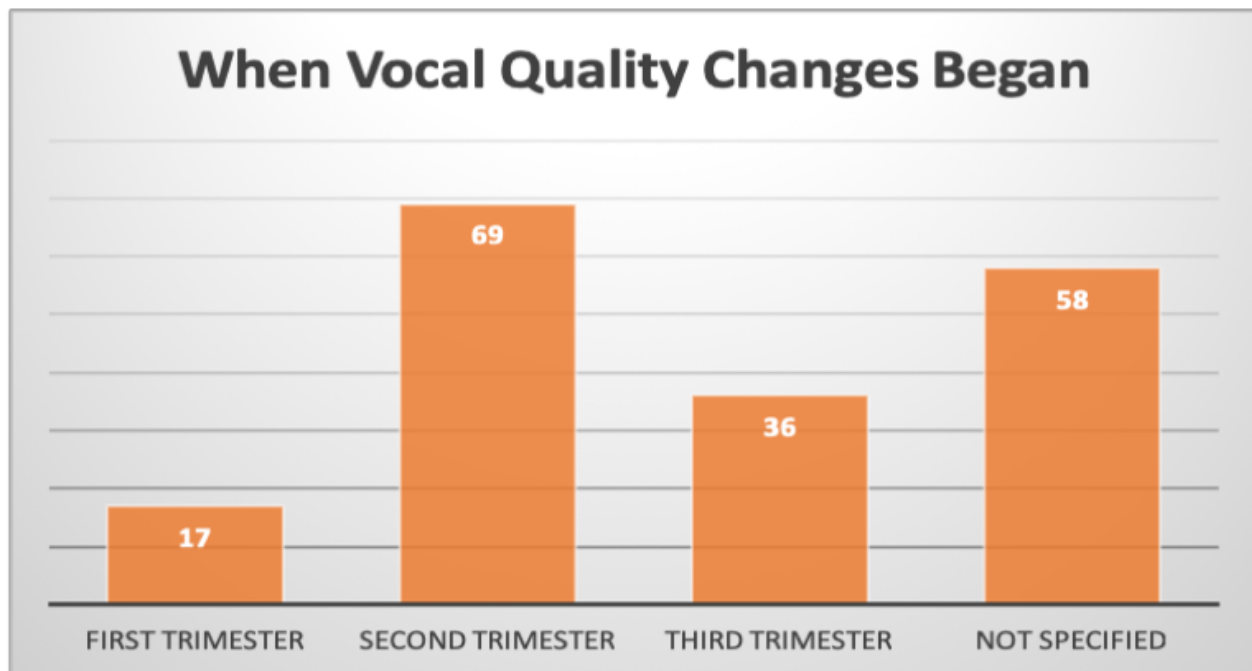


Figure 4.3

To answer the question about what women were told about the effects of pregnancy on vocal quality versus what they experienced, **Figure 4.4** shows that 36% received some

information that matched some of their experience, 26% received information that matched their experience, 16% received information but did not experience what they were told, 12% experienced changes but had not received information prior to experience, and 10% were inconclusive from a lack of data.

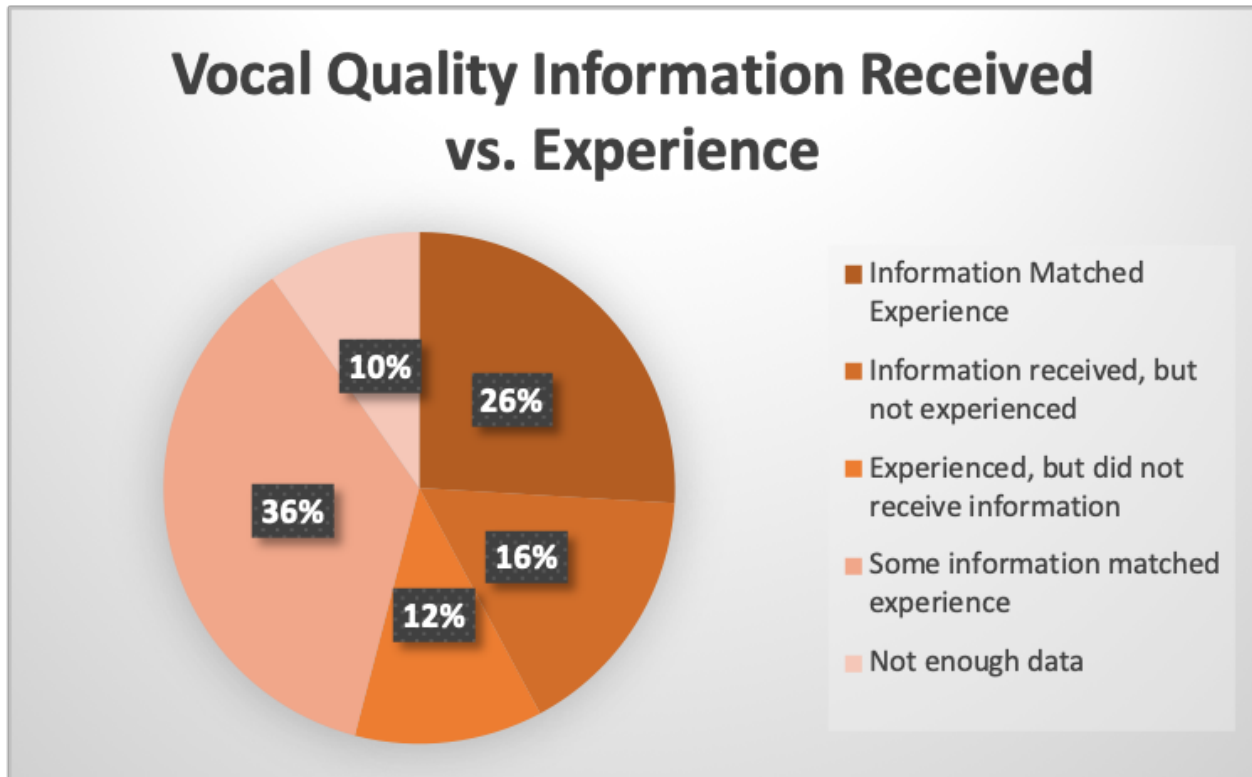


Figure 4.4

Vocal Mechanism

Of the 532 total responses 31% (165) reported they received information about possible vocal mechanism changes during pregnancy and 69% (367) reported that they did not receive any information. Of the information received, 7% (56) reported they received information from their friend or colleague, 6% (40) received information from their teacher, 5% (44) received information from the internet, 3% (21) received information from books, 8% (65) received information from their physician, 1% (5) received information from their director, 1% (3)

received information from another unlisted source, and 0% (0) received information from their agent. See **Figure 5.1** for a graphical display.

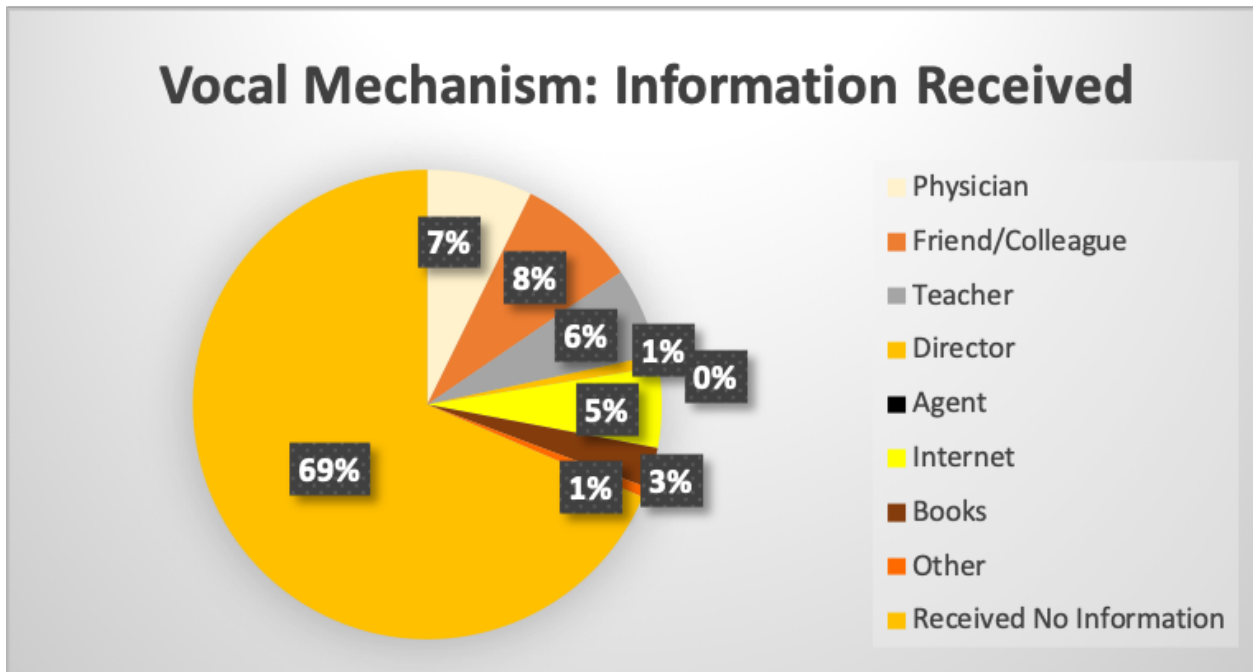


Figure 5.1

Of the 167 people that completed this section, the most commonly reported change in vocal mechanism during pregnancy reported was GERD (gastroesophageal reflux disorder) at 54% (90). The second most commonly reported change was rhinitis at 31% (52). The third most commonly reported change was edema at 15% (25). See **Figure 5.2** for a graphical display.

To answer the question about what women were told about the effects of pregnancy on vocal mechanism versus what they experienced, **Figure 5.3** shows that 29% received some information that matched some of their experience, 21% received information that matched their experience, 17% received information but did not experience what they were told, 13% experienced changes but had not received information prior to experience, and 20% were inconclusive from a lack of data.

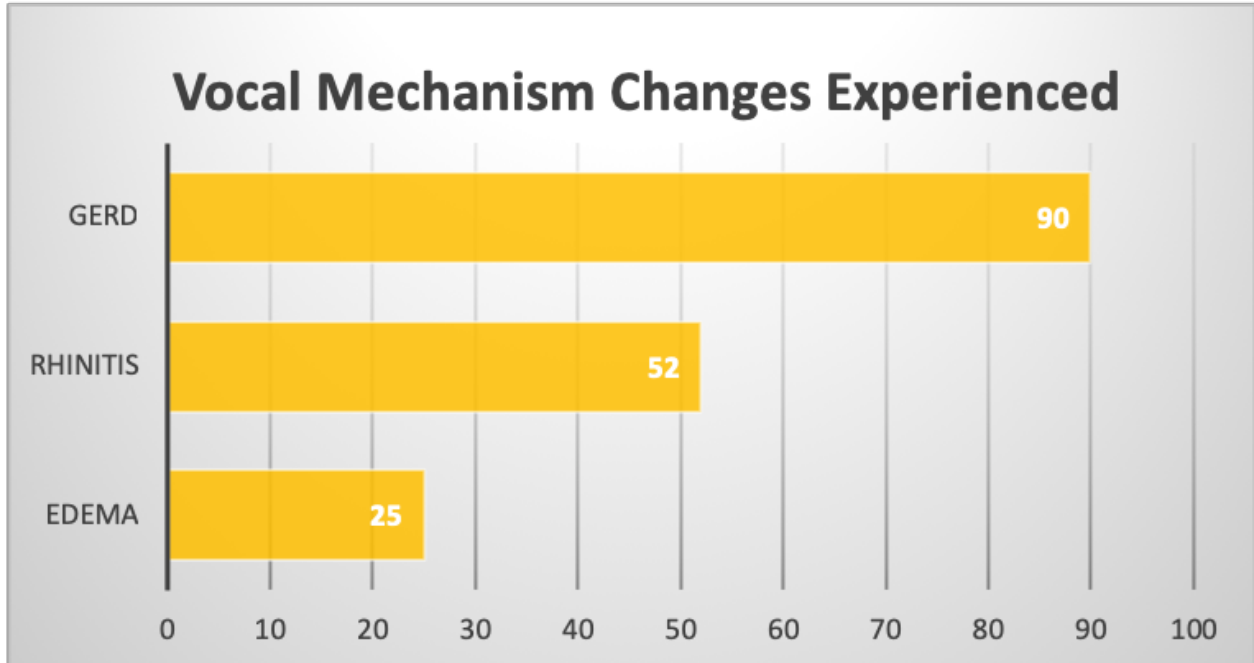


Figure 5.2

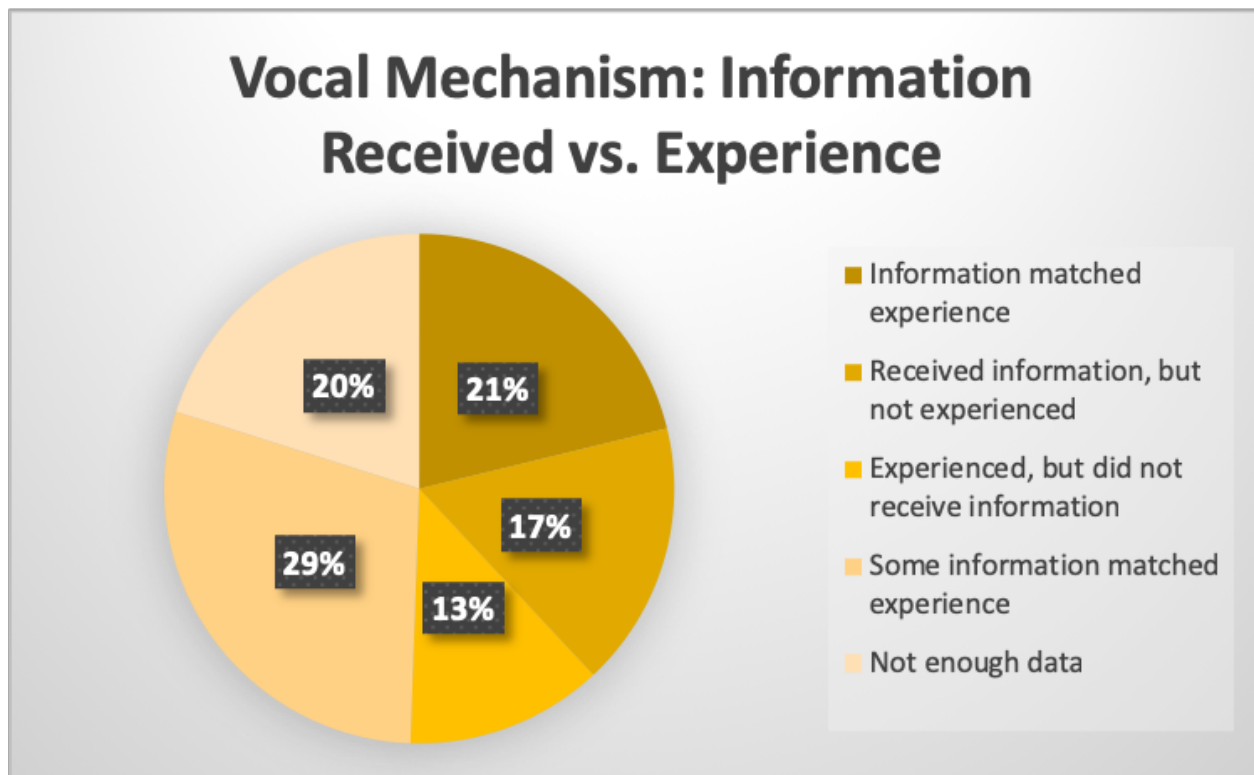


Figure 5.3

Additional Considerations

Participants were asked to specify if they adjusted their performance or teaching load during pregnancy and how long into their pregnancy they were able to continue certain voice related activities. They were asked to select all that apply, so results display a sum greater than that of the 185 total participants. Of the 337 total responses, 21% (72) reported that they adjusted their performance load during pregnancy, 25% (84) reported they did not adjust their performance load and 4% (14) reported this was not applicable to them. 10% (34) reported they adjusted their teaching load during pregnancy, 25% (83) reported they did not adjust their teaching load, and 15% (50) reported this was not applicable to them. See **Figure 6.1** for a graphical display.

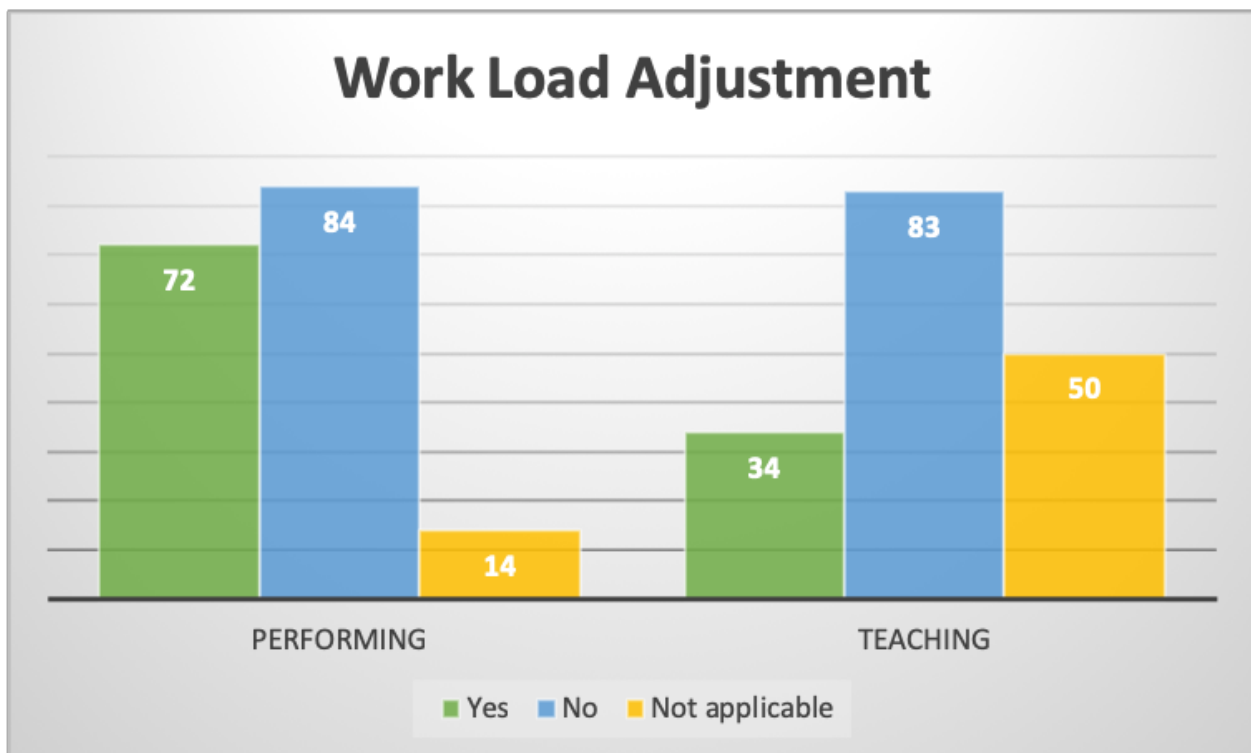


Figure 6.1

Of the 514 total responses, 1% (6) reported they could only continue professional vocal use (performances and otherwise) 2-3 months into pregnancy, 3% (14) reported they continued

4-5 months, 9% (48) reported they continued 6-7 months, and 14% (74) reported they continued 8+ months. Regarding the continuation of recreational vocal use (non-performance related), 1% (4) reported they continued 2-3 months into pregnancy, 1% (3) reported they continued 4-5 months, 2% (11) reported they continued 6-7 months, and 21% (110) reported they continued 8+ months. Regarding the continuation of teaching responsibilities, 1% (4) reported they could 2-3 months into pregnancy, 1% (4) reported they continued 4-5 months, 5% (28) reported they continued 6-7 months, and 15% (75) reported they continued 8+ months. Regarding the ability to phonate (generally make sound), 1% (5) reported they continued 2-3 months into pregnancy, 0% (1) reported they continued 4-5 months, 3% (13) reported they continued 6-7 months, and 22% (114) reported they continued 8+ months. See **Figure 6.2** for graphical display.

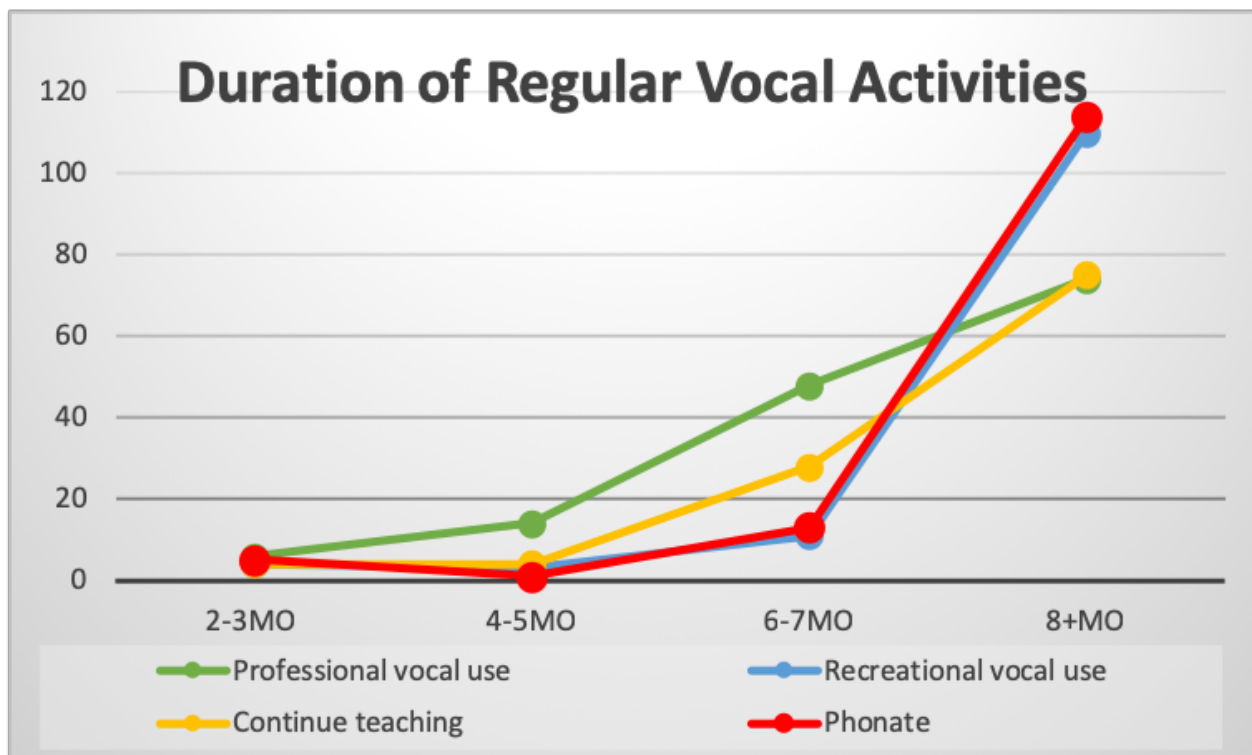


Figure 6.2

Of the 168 total participants who completed this section, 6% (10) strongly agreed that their overall experience singing during pregnancy matched what others told them to expect

during pregnancy, 27% (46) agreed, 30% (50) somewhat agreed, 21% (35) neither agreed not disagreed, 10% (16) somewhat disagreed, 2% (4) disagreed, and 4% (7) strongly disagreed. See **Figure 6.3** for a graphical display.

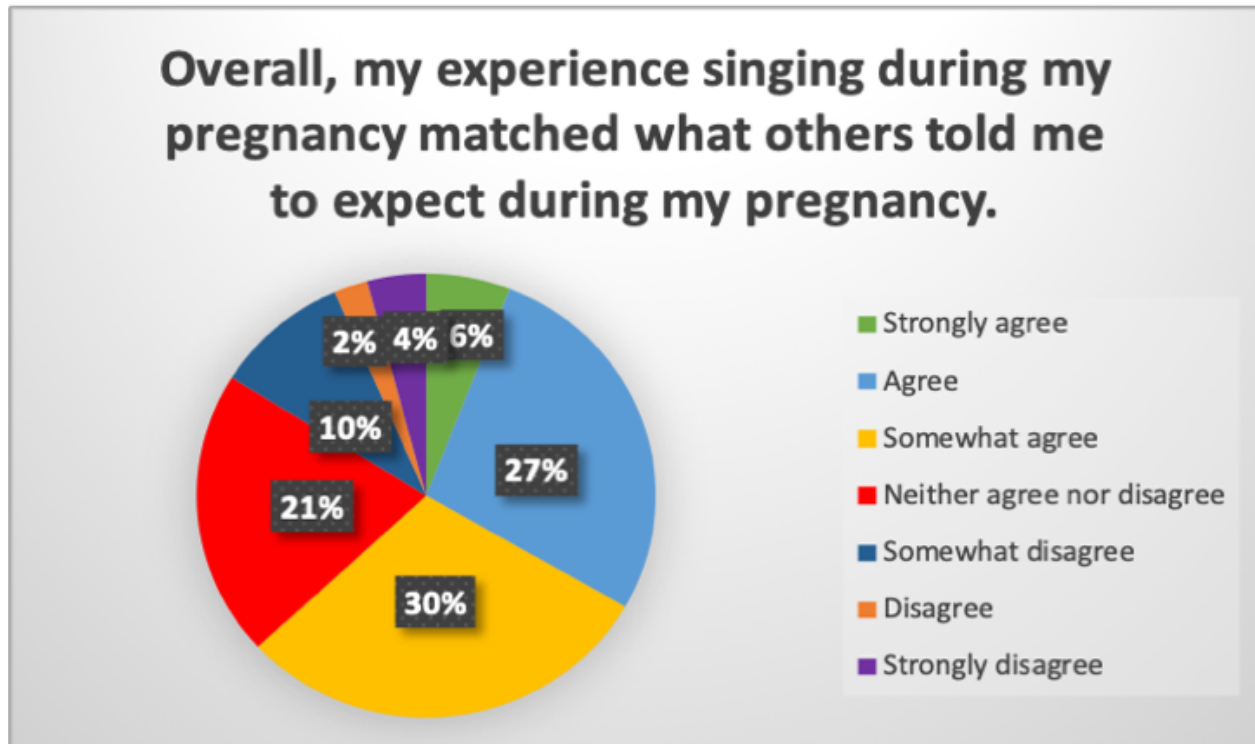


Figure 6.3

Of the 184 participants who completed this section, 48% (89) reported that they experienced vocal changes after pregnancy, 25% (45) did not experience vocal changes after pregnancy, 16% (30) reported that they may have had vocal changes after pregnancy, and 11% (20) were inconclusive from a lack of data. See **Figure 6.4** for a graphical display.

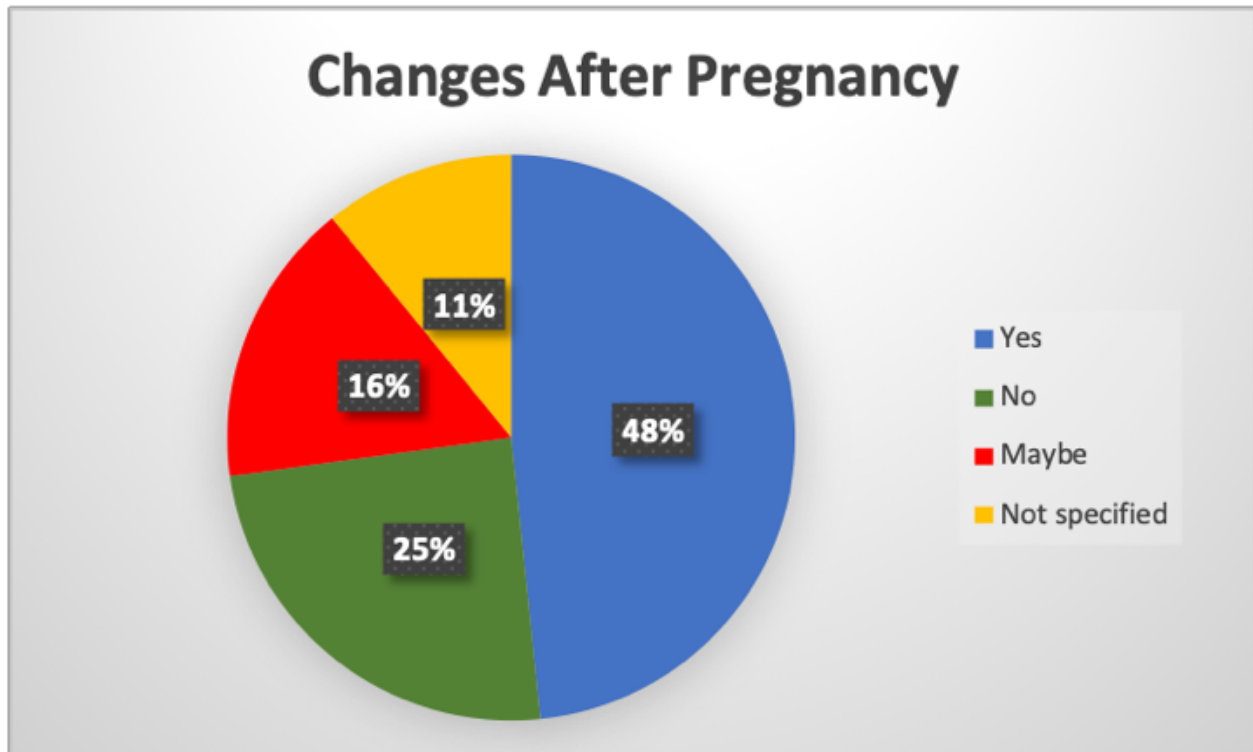


Figure 6.4

Discussion

The aim of this study was to clarify what information women are receiving about possible effects of pregnancy on their voice and their singing. The project was designed to give both the community of singers who have been, or may become pregnant, and those treating, training, or working with pregnant singers a clearer understanding of what effects a female singer may experience when pregnant. The survey was also created in hopes of helping to bridge the gap in the scientific literature and begin a line of research to accurately capture the experiences of singers who may be or wish to become pregnant.

Potential societal benefits of this study include an increased understanding of what women are being told about possible effects of pregnancy on the singing voice in conjunction with what women are actually experiencing. Pedagogically, this research has the potential to inform pedagogues, music educators, and professional singers of the extent to which pregnancy

can affect the singing voice. This can aid in personal scheduling of teaching and performance responsibilities, understanding certain voice changes, and education when teaching a pregnant student. This research may also help to relieve the sense of “taboo” associated with pregnancy and professional performance. It may also help educate women who are thinking about becoming pregnant or already pregnant to know about what may be expected during pregnancy and after birth.

In general, data concluded that there is a wide array of possible effects of pregnancy on the voice, very limited information is being shared regarding the subject, and no two pregnancies are the same. Regarding the information received by participants, the category with the most information given before pregnancy was breathing (only 42% reported receiving no information); whereas, for the categories of both phonation and vocal quality, a staggering 80% did not receive information prior to pregnancy. 69% of participants did not receive any information on vocal mechanism prior to pregnancy. Results from the survey revealed trends in the location from which the information was received. The largest group from which pre-pregnancy information was gleaned was friends and colleagues. Second to that was teachers followed by personal research online or in books. The only exception was regarding to vocal mechanism, where a substantial number of women received information from their physicians. One may conclude that there is a gap in knowledge, or at least the sharing of knowledge about this subject, among physicians and other music professionals, since the majority of information sharing is among friends and colleagues. To supplement this lack of information sharing, women tend to seek out information for themselves.

For breathing, the most commonly reported experiences were difficulty getting a full breath and difficulty sustaining long phrases. The majority of participants specified that they

began to notice these changes during the third trimester. One may conclude that this category is the most readily apparent to the singer, as the lung capacity is lessened exponentially faster in the final stages of pregnancy and the physical changes are more obvious than more subtle vocal changes. Although this was the category about which the most participants received information, only 21% of reported experience matched the information received.

Interestingly enough, a large number of respondents reported no noticeable changes in phonation during pregnancy. Of those reported, the most commonly seen were a downward shift in vocal range, difficulty with agility and coloratura, and difficulty sustaining in the upper register. As opposed to breathing, these changes were primarily noticed beginning in the second trimester, although the majority did not specify. Only 14% of reported experience matched the information received. When one considers that only 20% of women reported that they received information on the possible effects of pregnancy on phonation, it is not surprising that such a small number felt that it was a match. However, it is inconclusive as to whether these changes did not occur or if they were simply not noticed.

For vocal quality, an overwhelming majority of participants reported they experienced a darker/warmer vocal timbre, followed by a fuller/heavier timbre. These changes were primarily noticed beginning in the second trimester. For this category, 26% of their reported experience matched the information received and 36% had some match of information and experience. Although very little information about this category of possible effects seemed to be communicated, it had the largest portion of matching experience. One can conclude that this may be a more consistent experience among singers who are pregnant, even if it is not communicated beforehand.

The most commonly occurring experience affecting vocal mechanism during pregnancy was GERD. This is also a usual experience during pregnancy, whether or not one is a singer. Since this was discussed with physicians as well, it can be concluded that this is a frequently discussed effect of pregnancy both in and out of the music field.

When asked if they believed their experience matched the information received, the majority (63%) of the respondents selected either strongly agree, agree or somewhat agree. This is particularly interesting considering the small number of reported experiences that directly matched information received. This could be due to larger number of participants whose information received somewhat matched their experience, slightly skewing the perceived correlation between the two. This may also reveal a discrepancy between perceived experience and reported experience.

The majority of participants reported that they did not change their performance or teaching load. However, there was a staggering difference in the number of women who adjusted their performance loads as compared to those who adjusted their teaching loads (72 versus 34). This raises questions as to whether there is an external pressure placed on teachers to continue teaching during pregnancy as opposed to continuing a performance schedule. It may also reveal a discrepancy between the toll these vocal changes have on actively performing women as compared to teachers. The external effects of pregnancy may also play a role in a performer's schedule adjustment.

Similarly, the majority of women reported the ability to continue all voice related activities for the majority of their pregnancies. However, professional vocal use and teaching included more sporadic reports, tapering off at 6-7 months with fewer responses in the latter half of the pregnancies. Both recreational vocal use and general phonation were continued by most

participants throughout the duration of their pregnancies. One can conclude that as women progress in their pregnancies, their effects may become more readily apparent and therefore have more likelihood to interfere with heavily involved voice related activities.

After pregnancy, the majority of participants reported “yes” or “maybe” to having experienced vocal changes after pregnancy. Those that reported changes also stated that most of these changes were permanent. Although it is still unclear as to the reason behind these permanent changes, it can be concluded that the drastic influx in hormones during pregnancy has a lasting effect on the larynx.

Limitations of the Study

The primary limitations of this study stem from the information being anecdotal in nature, whereas definitive answers about what happens during pregnancy should employ controlled experimental studies. Another limitation is regarding potential selection bias in respondents. Although this cannot be fully determined, some respondents may have answered the survey because of previous problems with their voice during pregnancy, whereas others who did not have problems may have skipped the survey. This leaves the data biased towards people who had difficulties rather than gathering the full scope of pregnancy’s potential effects on the voice. As a result, we do not have a clear picture of the actual state of affairs. However, since the primary goal of the project was to gain further understanding into what information women are receiving in comparison to what they actually experience, the bias towards those who have experienced vocal problems is acceptable. The anecdotal data is also ecologically valid and provides a foundation of information for further research.

Future Research

Although the survey netted positive results and vastly increased the anecdotal knowledge on the effects of pregnancy on the singing voice, it opened up questions for further research based on the results reported. In the survey results, a large number of participants reported changes in vocal range and quality. The demographics did not ask for the *fach* or voice type of each woman, so it would be interesting to research possible correlations between voice type and specific vocal changes during and after pregnancy. A number of participants also commented about recovery from cesarean section versus vaginal birth. A future study on the differences in effects and changes dependent on delivery by cesarean section, vaginal delivery, or VBAC (vaginal birth after cesarean) could further the information on the subject. Similarly, some women reported participating in hormonal treatment or IVF (in vitro fertilization) before or during pregnancy. Although further questions were not asked regarding these treatments' effect on the singing voice, this could be an interesting path of future research. In in the survey, a few comments were received about noticeable vocal changes during and after breastfeeding. Since hormones continue to fluctuate while breastfeeding, a study on breastfeeding and its effects on the voice may be beneficial future research.

PART 4: SAMPLING OF SPONTANEOUS RESPONSES

Participants were given an opportunity to include additional comments in the “Demographics,” “Health Seeking Information,” and “Effects Experienced During Pregnancy” sections of the survey. These comments were not in analyzed in any way, but merely reflect further anecdotal responses directly from survey participants. The comments in the section do not include all participants, but rather highlight commonly reported spontaneous responses.

Demographics

Participants were asked what prompted them to seek out information about pregnancy and the voice in an open-ended question format. Many women sought information out of curiosity and interest in the subject. Others had heard information from previously pregnant colleagues and sought information as a result. The majority sought information in order to better inform themselves on how to manage possible vocal changes during pregnancy and continue their regular performance and teaching schedules. Others feared for the future of their singing careers and the possibly long-term vocal effects. Similarly, some women were planning gigs and sought to know how their pregnancy might affect their performance abilities. Others began to notice vocal changes during their pregnancies and in turn sought information to see if the two were related.

Breathing

Participants were asked for any additional comments regarding the information they received on the effects of pregnancy on breathing and what they experienced. A small number of women responded that they either did not receive any information on the subject prior to pregnancy or they did not experience any changes to breathing. Many women reported that they primarily gained information prior to pregnancy from friends, colleagues and personal study in books and online. Some comments include:

I did not receive any information about breathing difficulties while pregnant.

Received all of my information through experience and books.

[I] mostly heard from my female colleagues/friends about their experience singing while pregnant and how it was not as hard (until the last 4 weeks or so) as it was after giving birth, when there was no baby and you'd lost the sense of support.

The most common response included minimal, if any, breathing changes early in the pregnancy and increasing difficulty as the pregnancy progressed. Some women found pregnancy to have a negative effect on their breathing during singing. Some specific comments included:

I notic[ed] a disconnect with my breath.

[I had] difficulty with general feeling of over-exertion that makes breathing and sustaining phrases difficult.

[I] quickly fatigued and short of breath after only a short period of time spent singing.

[I had] difficulties singing staccato and coloratura due to challenges with abdominal muscles.

I had always thought that pregnant women experienced shortness of breath as the baby got larger and limited the ability of the lungs to expand. I was shocked to experience breathlessness very early on in pregnancy when I hardly even looked pregnant. The breathlessness became much worse as I got larger, to the point that I often found myself panting even after long periods of rest. I was shocked by how debilitating this was for me. It made it impossible for me to perform while pregnant, but it even limited my ability to teach.

Still, other women found pregnancy to have a positive effect on their breathing in singing. Some specific comments include:

My breathing improved during pregnancy.

I actually finally understood appoggio, as I had a more easily understood focus.

[I] found singing very easy and comfortable while pregnant

During second trimester, breathing was greatly improved due to being able to more accurately feel my diaphragm. Third trimester is where singing became much more difficult.

A lot of folks tried to tell me how hard breathing would be and assumed I would stop singing a few months before my due date because of it. However, I found breathing and long phrases to be the same, maybe even better/easier while fully pregnant. Perhaps because I had more weight and resistance in the abdominal area and was more aware of all my torso muscles all the time. I didn't notice any loss of breath until the two weeks before I delivered, and even then, it was minimal, and I still performed.

Phonation

Participants were asked for any additional comments regarding the information they received on the effects of pregnancy on phonation and what they experienced. Although there were minimal comments on information received, a few participants commented that they did not receive information any information on the subject and they received information from friends rather than physicians. Regarding experiencing phonation effects, participants experienced both positive and negative changes during pregnancy, all of which ranged in severity. Negative comments included difficulties with phonation in the middle voice, difficulty in the upper range, complete loss of voice, and intonation issues. Some specific comments on negative changes included the following:

With first pregnancy I lost about a fifth in top notes - never returned.

It took me longer to warm up.

Everything seemed so dark and suppressed. I had preeclampsia which was a huge impact on my voice toward the end of the third trimester.

No voice in third trimester. None. Sounded like a frog.

Due to support needed for phrasing under the staff, when I would take a low breath, it would be PAINFUL and my daughter let me know that she didn't like it either! I couldn't phonate above the staff without pain.

Difficulty belting high for a sustained period.

I experienced what I believe were some signs of vocal swelling: mild hoarseness, breathiness, and vocal fatigue.

I had trouble with intonation in my middle voice.

I didn't lose notes, but I did have issues with agility on certain notes (D6-F#6) that I hadn't previously experienced which started around 33/34 weeks.

Still, a large number of participants found pregnancy to have a positive effect on their phonation in singing, many claiming to sound better than they did prior to pregnancy. Some of their comments included the following:

My range definitely broadened after being pregnant. Both lower and upper extensions and the ability to cruise on top of the orchestra.

I had no problems with tonal production while pregnant. In fact, my voice seemed to be much stronger, as if on steroids.

Voice became much stronger.

My voice was better than ever.

Voice Quality

Participants were asked for any additional comments regarding the information they received on the effects of pregnancy on vocal quality and what they experienced. Although there were minimal comments in this section, a few participants commented that they did not receive any information on these possible changes. Other comments included experiences with increased vocal clarity and issues with vibrato. Some comments on positive experiences included the following:

I could sing quite well throughout pregnancy and didn't have any noticeable changes than a bit more grounding and richness, most noticeable in the lower range.

Voice became warmer and smoother. More mature (in a good way) and marketable sound. I sounded amazing both pregnancies.

More clarity of tone, actually!

Comments on negative experiences included the following:

Difficulty managing vibrato. vibrato got wider and faster, so it made pitch accuracy harder and I feel like it wasted a lot of my air. I am still experiencing this post-partum.

Pitch problems and wide vibrato.

The slight hoarseness could be caused by my current medication (Symbicourt).

Vocal Mechanism

Participants were asked for any additional comments regarding the information they received on the effects of pregnancy on the vocal mechanism and what they experienced. Although there were very few additional comments on vocal mechanism, the majority of comments indicated symptoms of GERD more frequently than rhinitis and edema. There were no reports of positive effects. Some comments included the following:

[I had] excess phlegm and mucous

I had GERD to begin with, the pregnancy just exacerbated it.

Mine may not have been full blown GERD, but there were certainly reflux issues. Also, severe back pain and difficulty with good posture can often become an issue.

I had reflux for half of the second and all of the third trimester. I sounded like a bass frog.

My nose is really stuffy, and when I am practicing, especially during the warm up, I have a lot of excess mucus and saliva. The tone is a bit dirtier at first from mucus, so I need to warm up a longer.

Additional Considerations

Participants were asked to include any additional comments about the vocal and mechanical changes they experienced after pregnancy. The majority of respondents reported that they experienced some sort of vocal change following their pregnancies, most of which remained permanent. Some responded that their changes were only temporary and very few comments reported no noticeable vocal change postpartum. Although the majority reported some sort of

noticeable effect of pregnancy on the voice postpartum, there was no one consistent experience among women, although there were trends regarding certain changes.

A large number of women reported they felt better breath support or better access to their breathing muscles postpartum. Still, others reported a disconnect with the breath or feeling different sensations during breathing while singing than prior to pregnancy. Many of these changes were reported to be permanent, although some negative breathing effects resulting from the trauma of vaginal birth or cesarean section were reported to have gone away over time. Similarly, a large number of women commented on vocal fatigue postpartum. Although this could be hormonal, it is impossible to separate the causation from correlation—the fatigue could be from general fatigue from sleepless nights and physical exhaustion. Some comments on the effects of pregnancy on breathing postpartum included the following:

As the body recovered from pregnancy and delivery, it took a while before I was able to get back in fighting shape. I do find that supporting from low is easier as I am much more aware of that portion of my body now.

Abdominal muscles took a long time to recover, hence breathing was different for a while.

My abdomen felt completely different after pregnancy, and it took nearly 1.5 years to return to pre-pregnancy comfort with respiration.

I feel like my voice matured, and after birth I was able to work on my core muscles through baby/mommy yoga and that helped me get a better understanding of my core. [I had] better access to breathing muscles.

[I] had to work hard to reconnect to my core and strengthen my core.

[I had] a feeling of disconnect with my body and my ability to breathe.

Much easier to find breath/stay on the breath postpartum. My hypothesis is that it's because my abs got all stretched out and I am now able to move more freely in that area.

I had to re-learn how to use my body, which was less toned than it had been before pregnancy.

General exhaustion and hormonal adjustments from the labor and postpartum process had significant effects on my voice until about 10 weeks postpartum.

Regarding voice quality changes postpartum, the majority of women reported to have richer, warmer, darker, or heavier/fuller tones, many of which reported as permanent changes. Women that experienced these changes tended to also have a lowered vocal range or more richness specifically in their middle to low registers. However, some women also reported an expansion of range or shift higher. A large number of women reported to have changes in the middle voice, whether in vocal quality or ability to navigate. Some found their middle voice to gain stability while others reported it to be unwieldy and heavy. Similarly, many participants commented on a loss of vocal agility--some temporary and some permanent. Some comments on the effects of pregnancy on vocal quality postpartum included the following:

My upper notes have not returned. 15 months postpartum. My lower notes have never been fuller though.

Bigger range (low and high), unwieldy middle register, muscle tension dysphonia due to lack of guidance in relearning technique.

My middle voice felt heavy and muddy. My top came back pretty well, and my agility overall returned.

Upward vocal shift sustained.

My voice range has gotten higher. Also, my passaggio has changed.

No longer a mezzo- range went much higher!!

My voice got heavier and my top expanded dramatically.

The ability to float and the range extensions have stayed as well as a greater trust in my ability to cruise over the orchestra, and not have to "work" so hard.

My vocal range lowered about a fifth (functionally) on both ends. After all these years of work we're working on a change in fach.

My voice remained richer and less agile. I'm also much more prone to hoarseness post-pregnancy.

Heavier instrument, maintained change of timbre to darker/warmer, passaggio shifted slightly.

Warmer/darker timbre, reduction in agility.

Lower range and warmer timbre were permanent changes.

Difficulty with coloratura for 1st year (now corrected).

Oh did I...I went from a coloratura soprano to a full lyric in the span of a few months. I still have the range, but the ease and agility I once had with notes C6-F#6 has decreased dramatically. My sound is warmer and fuller, and I feel much more at home singing bigger repertoire these days (Liu, Mimi, Donna Anna, Ellen Orford,). That being said, the bigger coloratura roles that aren't as high are definitely still doable too (Violetta, Vitellia, Anna Bolena).

Voice was heavier, it was more difficult to sing melismatic passages, inconsistent timbre over range, difficulty sustaining breath.

Participants were given the option to comment on what they wish they had known before pregnancy or any advice they would like to share with future expectant mothers. A large majority commented on the importance of body awareness and knowing one's self. Regularly, participants stressed that every pregnancy is different, so take the appropriate time needed to recover. A few participant comments emphasized how different their experiences were from what they were told, so to not expect one's pregnancy to be exactly like others. Some comments regarding advice or what they wish they had known included the following:

Take time after your baby is born to adjust to your drastically new life. You're not failing if you're not on the stage right away.

Everyone is different but expect some type of change.

Most of the factors that had me limiting my performing and/or teaching toward the end of pregnancy were not vocal issues but issues of fatigue and physical soreness and stamina.

Don't worry, it's not you! It's your hormones.

Staying in shape (keeping up with a good exercise regimen and healthy sleep and nutrition) seems to be a helpful way to manage symptoms of pregnancy both generally and for singing.

Due to hormonal changes, all muscles are affected, including those used in singing. I really enjoyed the changes on my vocal production and was told several times that my voice sounded better than ever (while pregnant). In addition, singing is incredibly beneficial for the unborn baby, whose sense of hearing develops around 20 weeks gestation. This is our first way of making sense of the world & a mother's voice is critical to our development.

It's amazing what you can do while pregnant. You feel very powerful growing a new life.

Proceed with caution: fulfilling engagements and maintaining a full schedule were a challenge. I wish I had left myself some flexibility in schedule AND repertoire.

Consistency was the most important thing to keeping my voice in shape (like when I was NOT pregnant!), but especially as my body changed, it was even more important to vocalize every day. My breath adapted, and I loved singing while pregnant.

Give yourself time to heal, especially if the birth experience was traumatic to mind and/or body.

I loved singing pregnant, at least until 7 months. As a naturally petite person, I liked the added weight in my core. It helped me feel more easily connected to my breath mechanism.

All of the healthy things you do for your baby are helpful for your voice, too!

Your voice may end up better after pregnancy!

Participants were given an opportunity to share any additional comments about their experience with the effects of pregnancy on the singing voice. Some women continued to comment on their experience during pregnancy and postpartum, while others included encouraging words to future mothers. Still others commented on the need for more information on the effects of pregnancy on the singing voice research, having personal experience with a lack of support within the professional singing world. Many also expressed appreciation for the research collected in the survey.

You can sing and have children. Make sure your partner is supportive.

Our bodies are amazing. As women, we are given a unique gift to bear life. This gift can only serve to enrich us as artists and better communicate the human experience with our audiences. Motherhood is to be celebrated, not penalized.

Everyone's pregnancy is different!

Every pregnancy is so different, so some women may face challenges that others never encounter. Open communication with your physician and your vocal teachers/colleagues is so important!

I wish pregnancy wasn't treated like a disease. I felt like I had to hide my pregnancies and any discomfort or problems I felt if I were going to get hired. And I felt completely disconnected from the professional world after giving birth. It was as if my choice to be a mother meant I should suck it up when it came to problems during pregnancy and quit singing once I had a child. The emotional lack of support was worse than the lack of knowledge.

Conclusion

Hormonal challenges and physical encumbrances take a toll on a woman's body during pregnancy. As a singer, these changes will affect her ability to sing. Much is assumed about what can happen to a woman's voice during pregnancy, but these are largely based on theoretical predictions, leaving a gap in knowledge of what actually happens. From this investigative survey, a better understanding of what women are told about the effects of pregnancy on the voice in comparison to what they actually experienced was gained. Although there is still much research to be done on the subject, a plethora of anecdotal information was gathered, and a foundation for further research was established.

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Appendix

PREGNANCY AND SINGING SURVEY

Start of Block: GENERAL PREGNANCY INFORMATION

Q1 Have you ever been pregnant?

Yes (1)

No (2)

Skip To: End of Survey If Have you ever been pregnant? = No

Q2 At what age(s) were you pregnant? Check all that apply.

18-25 (1)

25-30 (2)

30-35 (3)

35-40 (4)

40+ (5)

Q3 Were you actively studying music when you were pregnant?

Yes (1)

No (2)

Other (please specify) (3) _____

Q4 Were you actively performing when you were pregnant?

Yes (1)

No (2)

Other (please specify) (3) _____

Q5 How many pregnancies have you had past the first trimester?

1 (1)

2 (2)

3 (3)

4 (4)

5+ (5)

Q6 Were any of your pregnancies Cesarean section? If so, how many?

No (1)

1 (2)

2 (3)

3+ (4)

Q7 Prior to pregnancy, did you have any hormonal fertility treatment?

Yes (1)

No (2)

Q8 Did you have any difficulties/complications during pregnancy unrelated to the voice? (ie. gestational diabetes, preeclampsia, mandatory bed rest, infections, etc.)

Yes (1)

No (2)

End of Block: GENERAL PREGNANCY INFORMATION

Start of Block: DEMOGRAPHICS

Q9 What kind of singer are you? Check the ONE that best describes you:

Solo Singer (1)

Choral Singer (2)

Primary music educator (3)

Secondary music educator (4)

Higher music educator (5)

Private voice teacher (6)

Q10 Please select all others that apply to you:

Solo Singer (1)

- Choral Singer (2)
- Primary music educator (3)
- Secondary music educator (4)
- Higher music educator (5)
- Private voice teacher (6)

Q11 Highest degree earned:

- High school diploma (1)
- Associate's degree (2)
- Bachelor's degree (3)
- Artist diploma (4)
- Master's degree (5)
- Doctoral degree (6)

Q12 Highest level of vocal training:

- No formal vocal training (1)
- Private voice lessons (2)
- High school vocal experience (3)
- Training at the Associate's level (4)
- Training at the Bachelor's level (5)
- Training for an Artist diploma (6)
- Training at the Master's level (7)
- Training at the Doctoral Level (8)

Q13 In what style do you primarily sing? Select all that apply:

- Opera (1)
- Art Song (2)
- Oratorio (3)
- Musical Theater (4)
- Sacred/Church music (5)
- Jazz (6)

- Folk/Country (7)
- Gospel (8)
- Popular/Commercial (9)
- Rock & Roll (10)
- Other (please specify) (11) _____

End of Block: DEMOGRAPHICS

Start of Block: HEALTH SEEKING INFORMATION

Q15 When you were pregnant, did you receive any information about possible effects on your singing?

- Yes (1)
- No (2)

Q16 When you were pregnant or before you became pregnant, did you personally seek out information about your pregnancy's possible effect on your voice?

- Yes (1)
- No (2)

Q17 What prompted you to seek out information on pregnancy and the voice?

Q18 Below you will find a column on the left listing possible changes in breathing during pregnancy about which you may have been informed. You will also see a list of individuals from whom you may have received that information. For each voice change please click on the box that correlates with the source of the information given. If none are listed, please select the "other" options.

	Physician (1)	Friend/Colleague (2)	Teacher (3)	Director (4)	Agent (5)	Internet (6)	Books (7)	Other (8)
Difficulty sustaining long phrases (1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Difficulty in getting a full breath (2)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Difficulty controlling exhalation in singing (difficulties in maintaining appoggio) (3)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sensations of breathing in the chest (4)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sensations of breathing in the back (5)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ease of breathing in singing (6)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify) (7)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify) (8)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify) (9)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Click to write
Statement 10
(10)

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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Q33 Below you will find a column on the left listing possible changes in phonation (voicing) during pregnancy about which you may have been informed. You will also see a list of individuals from whom you may have received that information. For each voice change please click on the box that correlates with the source of the information given. If none are listed, please select the “other” options.

	Physician (1)	Friend/Colleague (2)	Teacher (3)	Director (4)	Agent (5)	Internet (6)	Books (7)	Other (8)
Difficulty singing in upper register (1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Difficulty singing in and around passaggi (2)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Difficulty singing in lower register (3)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Difficulty singing with agility and coloratura (4)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Difficulty in legato/ sustained singing (5)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Upward shift in vocal range (6)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Downward shift in vocal range (7)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Difficulty singing over mezzo forte (medium loud) (8)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Difficulty singing under mezzo piano (medium soft) (9)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify) (10)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify) (11)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify) (12)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify) (13)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q34 Below you will find a column on the left listing possible changes in vocal timbre or quality of sound during pregnancy about which you may have been informed. You will also see a list of individuals from whom you may have received that information. For each voice change please click on the box that correlates with the source of the information given. If none are listed, please select the “other” options.

	Physician (1)	Friend/Colleague (2)	Teacher (3)	Director (4)	Agent (5)	Internet (6)	Books (7)	Other (8)
<hr/>								

Darker/ warmer vocal timbre (1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Brighter vocal timbre (2)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Difficulty producing clear tone (3)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Breathiness (4)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Brassy/string ent tone quality (5)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fuller/heavie r timbre (6)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hoarseness (7)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify) (8)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify) (9)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify) (10)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Other (please specify) (11)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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Q35 Click to write the question text

	Physician (1)	Friend/Colleague (2)	Teacher (3)	Director (4)	Agent (5)	Internet (6)	Books (7)	Other (8)
Vocal edema/ swelling (1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rhinitis (nasal swelling) (2)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gastroesopho geal reflux disorder (GERD) (3)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify) (4)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (5)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify) (6)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify) (7)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q19 Below you will find a column on the left listing possible general and vocal health activity to do during pregnancy about which you may have been informed. You will also see a list of individuals from whom you may have received that information. For each activity, please click on the box that correlates with the source of the information given. If none are listed, please select the “other” options.

	Physician (1)	Friend/Colleague (2)	Teacher (3)	Director (4)	Agent (5)	Internet (6)	Books (7)	Other (8)
Change practice habits (1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Limit vocal use (2)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Limit upcoming performances /auditions (3)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Change exercise habits (4)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Change nutrition (5)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Limit food intake in the evenings (6)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Drink extra water (7)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Continue to sing normally (8)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Other (please specify) (9)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify) (10)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify) (11)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify) (12)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

End of Block: HEALTH SEEKING INFORMATION

Start of Block: EFFECTS EXPERIENCED DURING PREGNANCY

Q33 When you were pregnant, which of the following changes in breathing did you EXPERIENCE? Check all that apply:

- Difficulty sustaining long phrases (1)
- Difficulty in getting a full breath (2)
- Difficulty controlling exhalation in singing (difficulties in maintaining appoggio) (3)
- Sensations of breathing in the chest (4)
- Sensations of breathing in the back (5)
- Ease of breathing in singing (6)
- No noticeable changes to breathing in singing (7)
- Other (please specify) (8) _____
- Other (please specify) (9) _____
- Other (please specify) (10) _____
- Other (please specify) (11) _____

Q30 At what time during your pregnancy did you begin experiencing these breathing changes?

- First trimester (1)
- Second trimester (2)
- Third trimester (3)

Q20 When you were pregnant, which of the following changes in phonation (voicing) did you EXPERIENCE? Check all that apply:

- Difficulty singing in upper register (1)
- Difficulty singing in and around passaggi (2)
- Difficulty singing in lower register (3)
- Difficulty singing with agility and coloratura (4)
- Difficulty in legato/sustained singing (5)
- Upward shift in vocal range (6)
- Downward shift in vocal range (7)
- Difficulty singing over mezzo forte (medium loud) (8)
- Difficulty singing under mezzo piano (medium soft) (9)
- No noticeable changes in phonation in singing (10)
- Other (please specify) (11) _____
- Other (please specify) (12) _____
- Other (please specify) (13) _____
- Other (please specify) (14) _____

Q31 At what time during your pregnancy did you begin experiencing these phonation (voicing) changes?

- First trimester (1)
- Second trimester (2)
- Third trimester (3)

Q22 When you were pregnant, which of the following changes in vocal timbre or quality of sound did you EXPERIENCE? Check all that apply:

- Darker/warmer vocal timbre (1)
- Brighter vocal timbre (2)
- Difficulty producing clear tone (3)

- Breathiness (4)
- Brassy/stringent tone quality (5)
- Fuller/heavier timbre (6)
- Hoarseness (7)
- No noticeable changes in vocal timbre or tone quality (8)
- Other (please specify) (9) _____
- Other (please specify) (10) _____
- Other (please specify) (11) _____
- Other (please specify) (12) _____

Q32 At what time during your pregnancy did you begin experiencing these timbre or quality changes?

- First trimester (1)
- Second trimester (2)
- Third trimester (3)

Q23 When you were pregnant, which of the following other changes to the vocal mechanism did you EXPERIENCE? Check all that apply:

- Vocal edema/swelling (1)
- Rhinitis (nasal swelling) (2)
- Gastroesophageal reflux disorder (GERD) (3)
- Other (please specify) (4) _____
- Other (please specify) (5) _____
- Other (please specify) (6) _____
- Other (please specify) (7) _____

Q24 Did you have to adjust your performing load while pregnant?

- Yes (1)
- No (2)
- Not applicable (3)

Q25 Did you have to adjust your teaching load while pregnant?

- Yes (1)
- No (2)
- Not applicable (3)

Q26 How long into your pregnancy were you able to continue the following singing related activities? Please drag the item into the appropriate time frame of pregnancy:

2-3 months	4-5 months	6-7 months	8+ months
<input type="text"/> Professional vocal use (performances or otherwise) (1)	<input type="text"/> Professional vocal use (performances or otherwise) (1)	<input type="text"/> Professional vocal use (performances or otherwise) (1)	<input type="text"/> Professional vocal use (performances or otherwise) (1)
<input type="text"/> Recreational vocal use (non-performance related) (2)	<input type="text"/> Recreational vocal use (non-performance related) (2)	<input type="text"/> Recreational vocal use (non-performance related) (2)	<input type="text"/> Recreational vocal use (non-performance related) (2)
<input type="text"/> Continue teaching (3)	<input type="text"/> Continue teaching (3)	<input type="text"/> Continue teaching (3)	<input type="text"/> Continue teaching (3)
<input type="text"/> Phonate (generally make sound) (4)	<input type="text"/> Phonate (generally make sound) (4)	<input type="text"/> Phonate (generally make sound) (4)	<input type="text"/> Phonate (generally make sound) (4)

Q32 Overall, my experience singing during my pregnancy matched what others told me to expect during my pregnancy.

- Strongly agree (1)
- Agree (2)
- Somewhat agree (3)
- Neither agree nor disagree (4)
- Somewhat disagree (5)
- Disagree (6)
- Strongly disagree (7)

End of Block: EFFECTS EXPERIENCED DURING PREGNANCY

Start of Block: ADDITIONAL QUESTIONS AND COMMENTS

Q27 Did you experience any vocal changes *afte* rpregnancy?

Yes (please specify) (1) _____

Maybe (2)

No (3)

Q28 What do you wish you had known that you could share with other expectant singers?

Q29 Any additional comments to share?

End of Block: ADDITIONAL QUESTIONS AND COMMENTS