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Body Weight, Nutrition, and the Classical Singer: A Review of the Existing Literature

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UNIVERSITY OF MIAMI

BODY WEIGHT, NUTRITION, AND THE CLASSICAL SINGER: A REVIEW OF
THE EXISTING LITERATURE

By

Rebekah Kaye Smeltzer

A DOCTORAL ESSAY

Submitted to the Faculty
of the University of Miami
in partial fulfillment of the requirements for
the degree of Doctor of Musical Arts

Coral Gables, Florida

May 2017

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SINGER: A REVIEW OF THE EXISTING LITERATURE

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Body Weight, Nutrition, and the Classical Singer:
A Review of the Existing Literature.

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The discussion of body weight and the classical singer is not new, but recent events, such as HD broadcasts of opera productions, along with rising obesity rates across the general populace, have led to increased debate surrounding the stereotype of the overweight opera singer. As overweight singers face increased pressure to lose weight, a variety of suggestions have traveled through the vocal community, but little evidence-based research or health care advice has been readily available. Research has been conducted which seeks to answer how obesity affects vocal function, as well as how bariatric surgery may affect the voice; however, this research has not been widely circulated in the vocal community. Additionally, singers may desire to lose weight, but are subjected to the same advertising and fad diet promotions as the general populace, which leaves a great deal of uncertainty about the best methods to use. This paper provides a collection and brief analysis of the available research regarding body weight and nutritional issues and their relationship to vocal function, in order to bring more science and evidence-based research into this discussion of obesity, nutrition, and the classical singer.

DEDICATION

In memory of my amazing dad, who introduced me to the magical world of theater, and supported my every venture.

ACKNOWLEDGEMENTS

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Chapter 1

One of the most prevalent stereotypes concerning classical singers, particularly those singers who focus on operatic repertoire, relates to body weight. In contemporary culture, an opera singer is often portrayed as significantly overweight. While some classical singers are overweight, many are not. Increased pressure has been put on overweight singers to defy the stereotype and lose weight, or risk losing their contracts, as was illustrated in the infamous case of internationally renowned soprano Deborah Voigt and the “Little Black Dress.”¹ In 2004, Ms. Voigt was fired from the Royal Opera House’s production of *Ariadne auf Naxos* at Covent Garden over the director’s concerns about Voigt fitting into the costume, a black cocktail dress. Ms. Voigt ultimately had gastric bypass surgery and continued her singing career.

This incident led to many serious discussions about singers and body weight. A problem arises when voice teachers, stage directors, or singers attempt to define what body type or size is ideal or necessary for classical singing. This attempt is particularly hazardous as most of these definitions are based on popular opinion or observation, rather than scientific or medical research. For example, renowned soprano Dame Kiri te Kanawa stated in an interview, “You’ve got to have beef on you if you’re going to sing.”²

Although the discussion of weight and classical singers is not new, the attention given to this issue has increased in the past decade. In the online archives of *Classical Singer* magazine, a search for the term “weight” returned 358 results, with about 70 of

¹Anthony Tommasini, “With Surgery, Soprano Sheds a Brünnhilde Body,” *The New York Times*, March 27, 2005, accessed September 6, 2015, <http://nyti.ms/1hV4hlo>.

²Hannah Furness, “Opera Singers ‘Need a Bit of Beef’, Dame Kiri te Kanawa Says,” *The Telegraph*, June 11, 2013, accessed October 21, 2015, <http://www.telegraph.co.uk/culture/music/opera/10111095/Opera-singers-need-a-bit-of-beef-Dame-Kiri-te-Kanawa-says.html>.

those articles having body weight, weight loss, fitness, or health as a primary subject. Of the articles that were specifically focused on weight and weight loss, only seven were published between 1998-2005. From 2006 to 2016, nearly thirty articles on body weight alone have been published in *Classical Singer*. Also in 2006, the Metropolitan Opera began broadcasting some of its productions live in high definition (HD) in movie theaters around the country. While a direct connection between the two events may be difficult to prove, the advent of HD broadcasts has been suggested as a factor in the increased focus on singers and their body weight.^{3,4}

Justification

Rising worldwide obesity rates have prompted doctors to research obesity and its influence on daily life and activities, including how weight may influence vocal production.⁵ Despite many singers having an interest in their overall health, there is a dearth of reliable, evidence-based research being presented in vocal journals and magazines about body weight and its possible effects on vocal production.⁶ Opinions are given freely by teachers, coaches, and other professionals from the opera world, but very few of these opinions are supported by evidenced-based medicine, or cite any peer-reviewed sources.⁷ The few articles that can be found in vocal journals are often full of esoteric language, which can make them difficult to interpret. However, research on body

³Robert Thayer Sataloff, Alice G. Brandfonbrener, and Richard J. Lederman, eds., *Textbook of Performing Arts Medicine*, (New York: Raven Press, 1991), 240.

⁴Dahlia M. Sataloff and Robert Thayer Sataloff, "Obesity and the Professional Singer," in *Vocal Health and Science: A Compilation of Articles from The NATS Bulletin and The NATS Journal*, eds. Robert T. Sataloff and Ingo R. Titze (Jacksonville, FL: The National Association of Teachers of Singing, 1991), 105.

⁵Nancy P. Solomon, Leah B. Helou, Katie Dietrich-Burns, and Alexander Stojadinovic, "Do Obesity and Weight Loss Affect Vocal Function?," *Seminars in Speech and Language*, 32/1 (Feb 2011): 31-42.

⁶Robert Thayer Sataloff, ed., *Professional Voice: the Science and Art of Clinical Care*, 3rd ed. (San Diego: Plural Publishing Group, 2005), 658.

⁷Sharon Zarabi, "Nutrition and Weight Management," in *The Singer's Guide to Complete Health*, ed. Anthony Jahn (New York: Oxford University Press, 2013), 143.

weight and vocal function can be useful for voice teachers who want to help students achieve their fullest potential. A paper that provides access to the medical perspective on body weight and the singing voice, and synthesizes it in a way that is easy for singers and voice teachers to understand, can aid singers and their voice teachers in making the best choices for their vocal and physical health. Thus, this research is a potentially useful resource for educating singers about body weight and the voice.

With the advent of opera productions being broadcast in high-definition in movie theaters, the desire for svelte, attractive singers has increased. Voice teachers want students to remain competitive in the field, and this desire can include the pressure to lose a significant amount of weight.^{8,9} Knowledgeable teachers will want their students to proceed in as healthy and safe a manner as possible, but may not know how best to direct a singer in achieving weight loss goals.¹⁰ Often, teachers will repeat advice given to them, such as which muscle groups to avoid working, or a particular food or foods to avoid, but this information is rarely vetted through a reliable source, and is instead based on “what works for me.”¹¹ This paper provides a starting point for teachers who wish to support their students’ health goals while ensuring their primary objective of training the voice is fulfilled. Finally, this document provides a valuable liaison between the current medical research and the professional or career-oriented singer. Many singers are interested in maintaining optimal vocal health and know that physical health is a major component thereof. However, due to the high cost of health insurance, few singers are

⁸Barbara M. Doscher, *The Functional Unity of the Singing Voice*, 2nd ed. (Metuchen, NJ: The Scarecrow Press, Inc., 1994), 256.

⁹Meribeth Bunch, *Dynamics of the Singing Voice*, 4th ed. (New York: Springer-Verlag, 1997), 124.

¹⁰Doscher, xiii.

¹¹Zarabi, 143.

able to afford preventative care and only seek medical attention when they become ill.¹² Due to the obesity epidemic that is spreading not only across the US, but throughout the developed world, doctors are beginning to research the effects of excess weight in vocal tasks, including singing, speech, and other aspects of voice production.^{13,14} Singers are largely unaware of this research or its potential benefits in maintaining optimal physical and vocal health. Collecting this research serves to provide a resource containing medically sound advice and steps for maintaining good physical and vocal health.

The purpose of this paper is to provide vocalists and voice teachers a resource for research on body weight and the voice. These questions are addressed in the following chapters:

1. Does being overweight affect vocal production?
2. Does significant weight loss and/or bariatric surgery affect vocal production?
3. How do nutrition and singers' food choices play into overall health, and what steps can be taken to reduce health risks amidst the hectic life of a performer?

Delimitations

Due to the tremendous amount of material available on weight loss and obesity as general topics, this paper focused on research that addressed both body weight and vocal production. Resources were considered and included if they specifically addressed at least one of the following areas: vocal function under different weight conditions (obese, overweight, underweight, normal weight), vocal function during or after significant

¹²Joanna Cazden, *Everyday Voice Care: The Lifestyle Guide for Singers and Talkers* (Milwaukee, WI: Hal Leonard Corporation, 2012), ch. 12, loc. 1101, Kindle.

¹³Ben Barsties, et al., "Do Body Mass Index and Fat Volume Influence Vocal Quality, Phonatory Range, and Aerodynamics in Females?" *Codas* 25/4 (2013): 310-18.

¹⁴Saban Celebi, et al., "Acoustic, Perceptual, and Aerodynamic Voice Evaluation in an Obese Population," *The Journal of Laryngology and Otology* 127/10 (Oct. 2013): 987-90.

weight loss and/or bariatric surgery, or nutrition concerns of singers. Authors of these sources were medical practitioners, registered nutritionists, and/or nationally recognized and respected researchers or vocal pedagogues.

Chapter 2: Obesity and Vocal Production

Obesity is a rising concern across the world, not just for singers. Obesity is usually defined in reference to a number called the Body Mass Index, or BMI, which is found by taking a person's weight in kilograms and dividing it by his or her height in meters squared (kg/h^2). According to studies conducted by the Center for Disease Control, in 1996, no state in the US had an obesity rate (BMI > 30) greater than 20%. By 2006, every state except Colorado had an obesity rate greater than 20%, and four states had rates higher than 30%.¹⁵ Although BMI does not directly measure body fat, it has been found to correlate with more direct body fat measurements, such as skinfold thickness measurements and densitometry (underwater weighing).¹⁶ It is primarily used as a simple measure to assess possible weight issues, but it is not a diagnostic measure.¹⁷ Because BMI does not take muscle mass into account, it is possible for a person to have a BMI that indicates "overweight," when that person may have a low body fat percentage. However, because BMI is an easy calculation that requires no special equipment, both physicians and the general public find it useful in determining whether a person may have increased health risks due to their weight.¹⁸ BMI is organized into several ranges¹⁹:

Below 18.5	Underweight
18.5 - 24.9	Normal or Healthy Weight
25.0 - 29.9	Overweight
30.0 and above	Obese

¹⁵Mitchell S. Roslin, "Little Black Dress, Part 1," in *The Singer's Guide to Complete Health*, ed. Anthony F. Jahn (New York: Oxford University Press, 2013), 170.

¹⁶Centers for Disease Control and Prevention, "About Adult BMI," http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html (accessed Aug 31, 2016).

¹⁷Ibid.

¹⁸Ibid.

¹⁹Ibid.

As the rates of obesity have increased, additional markers have been introduced to clarify a person's level of obesity.²⁰

BMI level	Classification
30.0 - 34.9	Class I obesity
35.0 - 39.9	Class II obesity
40.0 and above	Class III obesity

Class III obesity is also referred to as “morbid obesity,”²¹ because the risk of serious obesity-related health conditions, also known as comorbidities, greatly increases at this BMI level.²² Frequently occurring obesity-related comorbidities include type II diabetes, heart disease, and hypertension (high blood pressure).²³

Although general obesity carries its own health risks, those risks increase with the occurrence of a greater percentage of abdominal fat.²⁴ The World Health Organization recommends measurement of waist circumference, while many other physicians and medical reports suggest waist circumference and waist-to-hip ratio as an additional measurements that may elucidate increased health risks due to a high amount of abdominal fat.²⁵

This brief overview provided a background on some of the risks of obesity, and the measurements that are commonly used to identify obesity, especially BMI. These associated health risks are serious, and should not be taken lightly. In addition to risks of

²⁰World Health Organization, “Obesity: Preventing and Managing the Global Epidemic,” *WHO Technical Report Series* 894 (Geneva, Switzerland: World Health Organization, 2000): 9.

²¹Dahlia Sataloff and Robert T. Sataloff, “Obesity and the Professional Voice User,” 657.

²²World Health Organization (WHO), 9, Table 2.1.

²³Dang M. Nguyen and Hashem B. El-Serag, “The Epidemiology of Obesity,” *Gastroenterology Clinics of North America* 39 (2010): 5, doi:10.1016/j.gtc.2009.12.014.

²⁴World Health Organization (WHO), 7.

²⁵Michael D. Jensen et al., “2013 AHA/ACC/TOS Guideline for the Management of Overweight and Obesity in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and The Obesity Society,” *Circulation* 129/suppl 2 (2014): S112.

stroke, heart disease, and diabetes, singers have additional concerns in which excess weight can be a hindrance, some of which are addressed below.

Excess weight can impact respiratory function, which can hinder a performer's endurance.²⁶ One particular concern is restrictive lung disease, which can decrease lung volume and respiratory efficiency. Even a mild case may reduce breath support enough to lead to increase neck and tongue muscular tensions, which in turn may cause phonotrauma, such as vocal nodules.²⁷

Obesity restricts the motion of the diaphragm, interferes with lung expansion, and increases the pressure in the abdomen.²⁸ This increased pressure leads to a higher occurrence of gastroesophageal reflux disease, or GERD.²⁹ Obesity also leads to increased risks of stroke and heart disease, excessive stress on hip and knee joints, and can disturb sleep patterns. Therefore, it is not surprising that Roslin suggests that obese vocalists sing well “despite their body habitus.”³⁰ Because obese singers have often been dealing with weight issues as long as or longer than they have been singing, obese singers may be in denial about the difficulties their weight causes in performance.³¹ If singers have been overweight or obese from a young age, they may not be aware that their diaphragm cannot move as freely, or the lungs cannot fully expand, because such persons will have no frame of reference for this freedom of movement.

²⁶Joseph R. Spiegel et al., “Respiratory Dysfunction,” in *Vocal Health and Pedagogy*, ed. Robert Thayer Sataloff (San Diego: Singular Publishing Group, 1998), 157.

²⁷Spiegel et al., 147.

²⁸Ibid., 157.

²⁹Roslin, 179.

³⁰Ibid., 167.

³¹Ibid., 170.

Obesity and Vocal Function

With the rise in concern over the growing obesity epidemic, doctors have been researching obesity and how it may influence day-to-day functions. One area of pertinent research is the effect of obesity on the voice and voice production. Voice production includes both speech and sung sounds. In the classical vocal world, doctors such as Robert Sataloff, who specialize in performing arts medicine, have long been aware of the problem of obesity and the classical singer, and began to address concerns about excess weight and the voice as early as 1991.³² Obesity is often defined in multiple levels, with obesity class III, or morbid obesity, being the most severe. The definition of morbid obesity is when a person is more than 100 pounds or 100% over ideal body weight;³³ however, breath support can be undermined by even a moderate level of obesity.³⁴ The authors mention the need for additional studies to document the effects of weight-loss surgery on the voice, but state that no significant problems have appeared thus far, and general health and longevity concerns may ultimately take precedence over vocal concerns.³⁵

Research studies on the effects of obesity and the vocal production are a fairly recent phenomenon. One of the earliest research studies to focus on the effects of obesity was conducted by Luca Busetto and his group in 2009, and it investigated the connection between obesity, upper airway size, and body fat distribution.³⁶ These researchers sought to determine whether relationships existed between obesity, fat distribution, and

³²Robert Thayer Sataloff, ed., *Vocal Health and Pedagogy*, San Diego: Singular Publishing Group, 1998.

³³Sataloff, *Professional Voice*, 658.

³⁴Ibid.

³⁵Ibid.

³⁶Luca Busetto et al., "Upper Airway Size is Related to Obesity and Body Fat Distribution in Women," *European Archives of Oto-Rhino-Laryngology*, 266/4 (Apr. 2009): 559-563. DOI: 10.1007/s00405-008-0773-y (accessed October 13, 2015).

pharyngeal morphology (shape of the throat). This study included 145 women, 95 of whom were overweight or obese. The remaining 50 were considered the control group. Height and body weight were calculated to determine Body Mass Index (BMI), and upper airway size was calculated through the use of an acoustic pharyngometer. Busetto et al. observed that both body mass and abdominal fat accumulation had an inverse correlation with pharyngeal cross-sectional area. The best predictor of a narrower upper airway, however, was the measurement of sagittal abdominal diameter, which suggests that high amounts of abdominal fat may be more important than obesity per se in determining upper airway size. This study further highlights the connection between greater levels of abdominal fat and negative effects of obesity.

Another landmark study in the research on obesity and the voice sought to characterize the voices of morbidly obese individuals, and compared the results with non-obese individuals to determine whether the voice of an obese person has particular traits that can be identified through perceptual and acoustic analysis.³⁷ The hypothesis was that an obese person's voice would have different characteristics than a non-obese person and that those characteristics would relate to body fat distribution. In an obese individual, abnormal fat deposits are distributed around the body, including the possibility of excess fat on the uvula, soft palate, lateral and posterior walls of the pharynx, and posterior region of the tongue.³⁸ Because these areas constitute major portions of the vocal apparatus, da Cunha et al. surmised that these fat deposits would affect vocal production. Participants included 45 adults with a BMI greater than 35, who were age and gender

³⁷Maria Gabriela Bernardo da Cunha et al., "Voice Feature Characteristic in Morbid Obese Population," *Obesity Surgery*, 21/3 (Mar. 2011): 340-344, DOI: 10.1007/s11695-009-9959-7 (accessed October 13, 2015).

³⁸da Cunha et al., 341.

matched with a control group. Both groups were subjected to a laryngoscopic examination, as well as perceptual analysis using the GIRBAS scale (Grade-Instability-Roughness-Breathiness-Asthenia-Strain). All laryngeal examinations were performed by the same doctor and later reviewed by two additional physicians. The perceptual analysis was completed and recorded by one of the researchers, and then verified by two independent speech therapists who were unaware to which group the person in the recording belonged. Da Cunha et al. reported that the obese individuals in the study had hoarseness, murmuring (breathiness), vocal instability, altered jitter (frequency variation between cycles) and shimmer (amplitude modulation between cycles), as well as reduced maximum phonation time (MPT), plus the presence of vocal strangulation at the end of emission.³⁹ The reduction in MPT was believed to be a direct result of excess weight. Accumulation of fat in the larynx makes it difficult for the laryngeal structures to adjust in the most conducive fashion, which can hinder efficient vocal production.⁴⁰

Obesity and Maximum Phonation Time

Celebi et al. also investigated vocal function in an obese population. The purpose of this study was to examine perceptual, acoustic, and aerodynamic voice parameters in obese individuals.⁴¹ Celebi et al. wanted to build upon previous research,^{42, 43} and discern if, in comparison with non-obese individuals, there were differences in any objective and subjective voice parameters among obese individuals. Additionally, they hoped to determine if analysis could characterize selected objective and subjective voice parameters for an obese population. For this study, 20 obese and 20 normal weight

³⁹da Cunha et al., 340.

⁴⁰Ibid., 344.

⁴¹Celebi, et al., 987-90.

⁴²da Cunha et al., 341.

⁴³Solomon et al., 31-42.

volunteers underwent voice evaluation by laryngoscopy, acoustic analysis, aerodynamic measurement, and perceptual analysis. Perceptual analysis was completed using the Grade-Roughness-Breathiness-Asthenia-Strain (GRBAS) scale, and the Voice Handicap Index-10 (VHI-10), a self-assessment questionnaire. Data were compared between groups. Aerodynamics were assessed by measuring the maximum phonation time (MPT) for the [a] vowel, and the s/z ratio. The s/z ratio test determines if a patient has difficulty sustaining an unvoiced (s) and voiced (z) consonant pair for the same amount of time. The participants were non-professional voice users, and the eight men and twelve women of the obese group (BMI greater than 35) were age and gender matched with a control group (BMI below 30). The age range of the participants was 27-49 years. Celebi et al. concluded that obese subjects had reduced maximum phonation time, and their vocal quality was deemed poorer by clinicians.⁴⁴ This study confirmed da Cunha et al.'s findings that obese patients have poorer maximum phonation time and poorer clinician-based assessment via the GRBAS scale. However, the responses to the self-assessment measures, such as the VHI-10 scores, did not differ between the obese group and control group. Similarly, the acoustic measures, such as jitter, shimmer, vocal intensity, noise-to-harmonic ratio, and s/z ratio recorded no significant differences between groups. Both of these results corroborated Solomon et al.'s findings⁴⁵ (further discussed in Chapter 3), but the overall results of this study lie somewhere between Solomon et al. and da Cunha et al.⁴⁶

Continuing to build upon the previous research that tracked maximum phonation time, as well as other vocal issues, de Souza et al. sought to relate fundamental

⁴⁴Celebi et al., 989.

⁴⁵Ibid.

⁴⁶Ibid., 990.

frequency, maximum phonation time, and voice complaints in morbidly obese women.⁴⁷ Namely, they questioned whether the change in available space in the vocal tract due to increased adipose (fat) tissue can cause acoustic variations in the voice, and asked if the effort to negotiate this adipose tissue to make resonating space in the laryngopharynx could cause changes in MPT.⁴⁸ The methods of this study included recording patients in both the obese group and a non-obese control group producing the vowel [a] at usual intensity for about three seconds, followed by testing MPT on vowels [a], [i], and [u]. The inclusion criteria for participants were: BMI higher than 35; not on hormone replacement therapy and/or drug treatment; not smoking; not having been intubated; and not having thyroid issues, such as hyperthyroidism or hypothyroidism. De Souza's findings support the earlier research of both Busetto and da Cunha and reference the contribution of fat deposits in the larynx and pharyngeal areas to the narrowing of the upper airway. The obese group patients in de Souza's study also presented with a high percentage of vocal complaints. De Souza explains the frequency of vocal complaints is likely due to the prevalence of type II muscle fibers found in the airway dilator muscles of obese subjects, which increases the likelihood of tension in sound production.⁴⁹ Type II muscle fibers, also called fast-twitch or fast-glycolytic muscle fibers are quick in response, but fatigue easily. Research has shown that patients with obstructive sleep apnea have an increase in type II muscle fibers in the airway dilator muscles.⁵⁰ Since

⁴⁷Lourdes Bernadete Rocha de Souza, et al., "Fundamental Frequency, Phonation Maximum Time and Vocal Complaints in Morbidly Obese Women," *Arquivos Brasileiros de Cirurgia Digestiva: ABCD = Brazilian Archives of Digestive Surgery*, 27/1 (2014): 43.

⁴⁸de Souza et al., 44.

⁴⁹Ibid., 45.

⁵⁰R. John Kimoff, "Upper Airway Myopathy is Important in the Pathophysiology of Obstructive Sleep Apnea," *Journal of Clinical Sleep Medicine* 3/6 (2007): 567, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2045720/> (accessed Aug 31, 2016).

obesity is often a cause of obstructive sleep apnea,⁵¹ it is likely that there is a connection between laryngeal and pharyngeal fat deposits and an increase in type II muscle fibers in the airway. Because these muscle fibers fatigue more easily, there is a greater risk of muscle overuse. Such overuse leads to greater vocal effort, which in turn leads to a higher frequency of vocal complaints.⁵²

De Souza's study also evaluated the fundamental frequency (f_0) of the women in this study. Fundamental frequency is the designation given to the habitual pitch of a person's speaking voice. Although the mean fundamental frequency was lower in the obese group than the control, the difference was not statistically significant.⁵³ However, statistical significance was found in the difference in maximum phonation time between groups. Three physiological factors are primarily responsible for MPT: total air capacity available, expiratory force, and glottal resistance.⁵⁴ MPT was statistically significant for all three vowels tested, which was explained by reduced respiratory muscle endurance, typically associated with excess fat tissue in the neck.⁵⁵ Additionally, de Souza suggested that increase in fat tissue in the neck can inhibit airflow, and cause difficulty in performing respiratory movements in the same amplitude as non-obese subjects, who do not have excess fat tissue in the neck,⁵⁶ and that this accumulation contributes to the imbalance of forces leading to reduced maximum phonation time. Overall, the research found that obesity contributes to a reduction in maximum phonation time. Thus, a

⁵¹WHO, 55.

⁵²de Souza et al., 45.

⁵³Ibid.

⁵⁴Ibid., 46.

⁵⁵Ibid.

⁵⁶Ibid.

primary cause of reduced MPT is the increased fat tissue found in the necks of obese people.⁵⁷

BMI, Voice Production, and Fundamental Frequency

Research connecting voice production and body mass index (BMI) is more recent, with initial studies primarily focused on fundamental frequency and habitual pitch. Hamdan et al.'s study of 40 men between the ages of 18 and 40 hypothesized that due to the larynx's role as a hormonal target, fundamental frequency could give information about body size.⁵⁸ Rise in testosterone levels during puberty is associated with lowering of vocal pitch.⁵⁹ Additionally, adipose tissue can also be a hormonal target, as it contains estrogen, progesterone, and androgen receptors.⁶⁰ Therefore, researchers hypothesized that the same hormonal environment that determines vocal identity also regulates the accumulation, distribution, and metabolism of fat in the body.⁶¹ However, their study ultimately found no statistically significant correlations between fundamental frequency, habitual pitch, and any of the weight analysis variables. The authors suggest the neglect of testing the subjects' testosterone levels and lack of body measurements such as chest circumference and waist-to-hip ratio as possible factors that could have negatively influenced the results of this study.

In 2013, Hamdan et al. published a second study, which was another attempt to correlate body mass composition and formant frequencies in men.⁶² The authors found a weak correlation between body mass composition and formant frequencies. However,

⁵⁷Ibid.

⁵⁸Abdul-Latif Hamdan, et al., "Relationship Between Acoustic Parameters and Body Mass Analysis in Young Males" *Journal of Voice*, 26/2 (Mar. 2012): 144.

⁵⁹Ibid., 145.

⁶⁰Ibid., 146.

⁶¹Ibid.

⁶²Abdul-Latif Hamdan, et al., "Formant Frequency in Relation to Body Mass Composition," *Journal of Voice*, 27/5 (Sept. 2013): 567-71.

Hamdan et al. did report concerns with this study including limited variance in subject selection. Fifty percent of the subjects were in the normal BMI range, with only ten percent in the obese range. The lack of a diverse subject group was considered a limitation by the authors. Although body fat percentages were measured, additional measurements that would have added to the researchers' knowledge about fat distribution were not taken, and this omission was listed as a limitation in the study.

During the same time frame, a study led by Barsties investigated the effects of BMI and fat volume in voice production in women.⁶³ This study specifically divided the subjects by weight into three groups: normal weight, under weight, and obese. Twenty-five different variables of voice production were measured, with ten of those variables showing statistically significant differences between groups. Included in the statistically significant variables were fundamental frequency, vital capacity (maximum and expected), and maximum phonation time. According to the study, these factors were influenced by body weight and body fat volume. This study supported previous research^{64,65} which proposed obese subjects will have reduced maximum phonation time and decreased vital capacity. In addition, Barsties et al. found that being underweight could also have an adverse affect on vital capacity and maximum phonation time, although the results were less significant than the findings in the obese group. Although weight appeared to affect factors such as vital capacity, shimmer, and maximum phonation time, Barsties et al. determined that weight did not affect many other factors of vocal production.

⁶³Barsties, et al., 310-18.

⁶⁴Busetto et al., 563.

⁶⁵da Cunha et al., 344.

In summary, Hamdan et al. initially discovered no significant correlations between fundamental frequency and habitual pitch with body mass and fat distribution. A subsequent study led by Hamdan found weak correlations between body mass composition and fundamental frequency in a group consisting primarily of normal weight males. Barsties et al. investigated BMI and vocal production issues in women of three weight categories, and reported that either being overweight/obese or being underweight can negatively affect maximum phonation time and vital capacity, as well as having a possible small effect on fundamental frequency.⁶⁶

⁶⁶Barsties et al., 317.

Chapter 3 - Bariatric Surgery and Weight Loss

One of the most drastic measures to bring about weight loss in an obese person is bariatric surgery. Bariatric surgery comes in several forms, but three of the most popular types are: Roux-en-Y gastric bypass, sleeve gastrectomy, and the laparoscopic adjustable gastric band (LAGB). Although these surgeries are often collectively referred to as “gastric bypass” surgeries, bariatric surgery is the more accurate term, as not all bariatric, or weight-loss, surgeries involve a bypass of the stomach and/or intestines. A short description of each of the three types of commonly performed bariatric surgeries follows. The Roux-en-Y procedure is the most commonly performed bariatric operation in the US.⁶⁷ It involves two surgical alterations: a restriction of gastric volume, and the diversion of ingested nutrients away from the proximal small intestine. Sleeve gastrectomy does not involve any bypass procedures; it is strictly a restrictive procedure. The stomach is reduced in volume by about 90% and becomes more like a narrow tube. Food is able to be absorbed normally with this method, but it is a non-reversible surgery. The laparoscopic adjustable gastric band (LAGB) was originally a one-size band, but developed into an adjustable band to suit patient needs and allow for greater success in weight loss and maintenance of weight loss.⁶⁸ The band is placed near the top of the stomach, and when adjusted correctly, creates early feelings of satiety. Weight loss can be slower with this method than other bariatric surgeries, but the weight loss is steadier, slower, and appears to be lasting.⁶⁹ If desired, it is possible for the band to be removed, making LAGB the only reversible bariatric surgery.

⁶⁷Youdim, Adrienne, ed., *The Clinician's Guide to the Treatment of Obesity* (New York: Springer, 2015), ch 7, loc. 3761, Kindle.

⁶⁸Ibid., loc. 4511.

⁶⁹Ibid.

Bariatric Surgery and Vocal Function

No studies are currently available that focus on bariatric surgery in singers. However, a few studies have investigated changes in vocal function related to bariatric surgery in non-singers. One study, led by Abdul-Latif Hamdan,⁷⁰ investigated the effects of weight loss on the voice after bariatric surgery. A total of nine subjects successfully finished the study, which began with a voice evaluation. This evaluation included laryngeal endoscopy, a perceptual evaluation using the grade, roughness, and breathiness measures from the GRBAS scale, plus acoustic analysis, which included fundamental frequency, shimmer, jitter, noise-to-harmonic ratio, voice turbulence index, maximum phonation time, and habitual pitch. Patients were also given a short questionnaire on voice quality, which included questions about a change in pitch (none, higher, or lower), change in loudness (none, increased, or decreased), change in phonatory effort (none, increased, or decreased), and vocal fatigue (present or absent). The study defined vocal fatigue as vocal tiring after an extended phonatory task, and phonatory effort was defined as the effort required to speak. Patients were evaluated at three to six months post-operatively.

After the surgery, there were no significant changes in either the laryngeal examinations or the acoustic analysis, although over half of the patients had an increase in MPT; they could sustain an [a] vowel for a longer amount of time. For the perceptual evaluation (the Grade, Roughness, and Breathiness scales), the mean grade and roughness were both lower, which is considered an improvement, but not enough to be statistically significant. The mean breathiness score increased slightly, but again, this increase was

⁷⁰Abdul-Latif Hamdan, et al., "Effect of Weight Loss on Voice after Bariatric Surgery," *Journal of Voice*, 28/5 (Sept. 2014): 618-23.

not considered statistically significant. Three of the nine patients self-reported changes in voice quality; all three had an increase in pitch, two had reduced loudness and an increase in phonatory effort, and one reported vocal fatigue. However, these changes were not registered by any of the clinical evaluations. Hamdan et al. proposed some possible rationales for these self-perceived vocal changes. The increase in phonatory effort and reduced loudness may connect with the general weakness and increase in fatigue experienced by patients who undergo bariatric surgery. Some degree of malnutrition is also possible during post-operative weight loss, although these patients were monitored and none showed signs of actual malnutrition. However, since diet is largely under the patient's control, it is possible some nutrients were lacking that contributed to patient fatigue, but not to the extent that malnutrition could be diagnosed. The increase in vocal pitch could be a result of some correlations between body size and fundamental frequency (f_0). Hamdan et al. referenced other studies⁷¹ that reported possible weak correlations between body size and f_0 . They also referenced the possible connections between sex hormones and body mass composition, which have been studied by Gates et al.⁷² and Evans et al.⁷³ Hamdan et al.'s final conclusions were that while weight loss does not appear to have an acoustic or perceptual effect on the voice, some patients may experience a change in voice quality. They suggested further studies connecting sex hormone levels and aeromechanics.

⁷¹Hamdan et al., "Effect of Weight Loss," 622.

⁷²Margaret A. Gates et al., "Sex Steroid Hormone Levels and Body Composition in Men," *The Journal of Clinical Endocrinology and Metabolism* 98/6 (2013): 2442-2450.

⁷³Sarah Evans, Nick Neave, and Delia Wakelin, "Relationships Between Vocal Characteristics and Body Size and Shape in Human Males: An Evolutionary Explanation for a Deep Male Voice," *Biological Psychology* 72/2 (2006): 160-163.

A second study that evaluated weight loss and vocal function was published by Nancy Solomon et al. in 2011.⁷⁴ This research evaluated two groups, a group of obese participants who underwent bariatric surgery during the study, and a non-obese group. Auditory-perceptual, acoustic, and aeromechanic measures were taken before surgery, then at two weeks, three months, and six months post-operatively. Each subject was evaluated with a flexible endoscope through the nasal passages to view the larynx. Acoustic measures included completion of the CAPE-V, a Voice Range Profile, and Maximum Phonation Time. A two-second segment of a sustained [a] vowel was analyzed acoustically for jitter, shimmer, and noise-to-harmonic ratio. Aeromechanic evaluation was completed to evaluate airflow, air pressure, and Phonation Threshold Pressure (PTP - the minimum amount of airflow needed to produce a particular pitch). All acoustic measures were found to be within normal limits, even from the first evaluation for both the obese and control groups. For the auditory-perceptual measures, although the measures were within normal limits for both groups, statistically significant differences were found for ratings of loudness between groups, with the obese group being slightly quieter than the non-obese group. Strain and pitch decreased slightly for both groups over the course of the study.

It is interesting that no statistically significant differences appeared for perceived voice quality, acoustic measures, or aerodynamic measures between obese and non-obese participants at the beginning of the study. The most significant measure from this study involved PTP. PTP decreased at both 30% and 80% of f_0 for both groups over the course of the study, but PTP 30% changed the most for the obese group. At the first session, this measure was outside of the normal range, but decreased over the course of the study. The

⁷⁴Solomon et al., 31-42.

authors reported that this finding indicates that it takes a greater amount of tracheal pressure to move the vocal folds into oscillation when a person is highly obese, and this pressure would decrease to some extent as a person loses weight.⁷⁵

Solomon et al. made a point of highlighting the differences in the findings of their study versus da Cunha et al.'s study,⁷⁶ and also elaborated on possible reasons why, including a lack of clarity in da Cunha et al.'s study concerning patients' medical profiles, methods of data collection, and possible clinical bias.⁷⁷ Solomon et al. urged future researchers to consider measurements such as neck circumference or airway diameter in evaluating obesity and vocal function, because measurements such as BMI do not account for muscle mass, frame size, or activity level. The major conclusion of this study is that while sound production likely does not differ between obese and non-obese individuals, vocal production may become easier as overall body mass decreases. This theory supports Anthony Jahn's declaration that obese singers sing well "because they have learned to compensate for the physiologic stress created by being overweight,"⁷⁸ and that ease of vocal production should increase with weight loss.

Bariatric Surgery: General Risks & Procedure Comparisons

Although the following sections highlight some issues that singers may face if they decide to undergo bariatric surgery, situations do exist in which surgery is the best option for overall health. Because of the prevalence of comorbidities, or medical problems/diseases which occur alongside (and often because of) morbid obesity, the risks of surgery may be outweighed by the potential benefit to the person's overall well-

⁷⁵Solomon et al., 39

⁷⁶da Cunha et al., 344.

⁷⁷Solomon et al., 40.

⁷⁸Anthony F. Jahn, ed. *The Singer's Guide to Complete Health*, Oxford: Oxford University Press, 2013, 167.

being.⁷⁹ An honest and thorough conversation with one's doctor is required to determine if a person is a good candidate for bariatric surgery. All bariatric surgeries use the following criteria to determine if a patient is a good candidate for bariatric surgery: Age, BMI greater than 40, or greater than 35 with at least one obesity-related comorbidity, such as Type II Diabetes or hypertension. Patients must have attempted weight loss through other measures and been unsuccessful. Additionally, patients must be reminded of the need for lifelong vitamin supplementation and follow up visits with a physician.⁸⁰ So what are some of the risks of bariatric surgery? Although morbidity rates are very low, (approximately 0.5%), there is a risk of death due to surgical complications with bariatric surgery.⁸¹ Specific issues for Roux-en-Y gastric bypass include possible leaks where the bypass limb is attached, hernias, ulcers, weight regain and vitamin deficiencies.⁸²

Sleeve gastrectomy is increasing in popularity as a bariatric surgery, because malnutrition is less of a concern, as nutrients continue to be absorbed normally in the body.⁸³ In terms of risk assessment and weight loss achieved, it falls between Roux-en-Y procedures and LAGB.⁸⁴ However, there is some evidence that suggests sleeve gastrectomy may worsen GERD (gastroesophageal reflux disease), due to the increased pressure in the stomach.⁸⁵ Some studies have shown improvement in GERD symptoms

⁷⁹Dahlia M. Sataloff and Robert Thayer Sataloff, "Obesity and the Professional Singer," 108.

⁸⁰Mechanick et al., 342.

⁸¹Youdim, loc. 3869

⁸²Lisa Ann Bayer, "Baseline Traits as Predictors of Success in Medical Weight Management" (Master's thesis, University of Minnesota, 2015), 17.

⁸³Bayer, 16.

⁸⁴Jeffrey I. Mechanick et al., "Clinical Practice Guidelines for the Perioperative Nutritional, Metabolic, and Nonsurgical Support of the Bariatric Surgery Patient — 2013 Update: Co-Sponsored by American Association of Clinical Endocrinologists, The Obesity Society, and American Society for Metabolic & Bariatric Surgery." *Endocrine Practice* 19/2 (2013): 339.

⁸⁵Youdim., loc 4185.

after sleeve gastrectomy, but without further studies, the evidence is inconclusive.⁸⁶ It is important to be aware that some physicians will avoid recommending sleeve gastrectomy for patients who already have GERD due to the conflicting information currently available.⁸⁷

The adjustable gastric band (LAGB) is attached laparoscopically at the upper part of the stomach, near the connection to the esophagus. The band is adjustable so that as a patient loses weight, the band is still able to restrict gastric volume.⁸⁸ Patients are instructed to eat very slowly, and portion sizes are generally the size of 1-1.5 decks of cards.⁸⁹ Risks specific to LAGB are mostly due to incorrect band placement or poor patient follow-up.⁹⁰ Although the LAGB is the only bariatric surgery to include the word laparoscopic in its name, laparoscopy is the preferred method for all bariatric surgeries, as well as other abdominal surgeries such as gallbladder removal.⁹¹ Laparoscopy is a surgical method that involves making several small incisions instead of one or two large incisions. A small camera is placed in one of the incisions so the surgeon can visualize the operation, and other incisions are used for the surgical tools. The small incisions (generally between 1/4 inch - 1 inch each) make surgeries less invasive, and recovery times are generally faster than in traditional open surgeries.^{92,93} Laparoscopic bariatric surgeries are preferable for singers, as the open versions require opening the abdominal

⁸⁶Ibid., loc. 4357.

⁸⁷Ibid., loc. 4185

⁸⁸Bayer, 16.

⁸⁹Youdim, loc. 4573.

⁹⁰Ibid., loc. 4705.

⁹¹Mechanick et al., 342.

⁹²Karen Wicklund, "Singers and Abdominal Surgery: Recovery and Rehabilitation of the Respiratory Processes," *Journal of Singing* 57/3 (2001): 7.

⁹³Betty Jean Vanek, "Pre- and Post-Bariatric Surgery Physical Activity Behavior Patterns: A Holistic Case Study" (Ph.D. diss., University of Northern Colorado, 2005), 54.

cavity and separating the abdominal muscles,⁹⁴ which can contribute to extended recovery time and time away from singing.

Dietary Changes after Surgery

After surgery, the patient begins with a sugar-free liquid diet, which continues for the first 1-2 weeks. A slow progression is then made over the next 4-5 weeks from pureed to soft foods. It takes approximately six weeks after surgery to return to a normal diet.⁹⁵ Food must be chewed thoroughly, otherwise there is risk of regurgitation.⁹⁶ Because the stomach volume is so greatly reduced, proteins must be eaten first, so as to avoid protein malnutrition.⁹⁷ There is also early risk of dehydration which should resolve as the swelling from surgery goes down.⁹⁸ However, due to reduced stomach size, patients are instructed to avoid drinking liquids with meals, and must instead wait 30 minutes after eating, so that sufficient space will be available in the stomach.⁹⁹ Although there is less likelihood of vitamin deficiency with sleeve gastrectomy than Roux-en-Y gastric bypass, vitamin supplementation is recommended for both.¹⁰⁰ Overall, sleeve gastrectomy has similar outcomes to Roux-en-Y gastric bypass in terms of weight loss and resolution of comorbidities, but gastrectomy tends to have lower overall complication rates.¹⁰¹

⁹⁴Johns Hopkins Medicine Health Library, "Gastric Bypass (Malabsorptive) Surgery Procedure," http://www.hopkinsmedicine.org/healthlibrary/test_procedures/gastroenterology/gastric_bypass_malabsorptive_surgery_procedure_92,P07988/ (accessed November 4, 2016).

⁹⁵Youdim., loc. 4239.

⁹⁶Ibid., loc. 4250.

⁹⁷Janet Followell, "Experiences of Women Before and After Bariatric Surgery" (Ph.D. diss., Southern Illinois University Carbondale, 2008), 34.

⁹⁸Youdim, loc. 4256.

⁹⁹Mechanick et al., 346.

¹⁰⁰Youdim, loc. 4262.

¹⁰¹Mechanick et al., 339.

Weight loss with LAGB is durable, but not as rapid as other bariatric procedures. Peak weight loss is usually reached about two years after surgery.¹⁰² LAGB is considered to be the safest and least invasive of the bariatric surgeries.¹⁰³ LAGB patients also begin with a liquid diet and gradually work up to solid foods. Caloric intake is typically between 800-1200 calories, and this level of caloric intake remains fairly constant while the band is in place.¹⁰⁴

Bariatric Surgery: Risks for Singers

One major reason for a singer to avoid bariatric surgery if possible is the effect of rapid weight loss on the voice. Rapid weight loss can cause metabolic shifts and feelings of weakness. These shifts can change voice quality and endurance.^{105,106} It has been suggested that part of the reason obesity was tolerated in singers was that historically, singers who lost weight rapidly also lost vocal and physical energy, but it was the loss of fat that was blamed for the change in sound, rather than the loss of energy.^{107, 108} However, singers do undergo bariatric surgeries, and continue to have careers if they manage their recovery well.

Few singers who have had the procedure talk openly about it, but one helpful resource is a chapter from *The Singer's Guide to Complete Health*, which was written by Ory Brown, a mezzo-soprano who had Roux-en-Y gastric bypass surgery in 2006.¹⁰⁹

¹⁰²Youdim, loc. 4635.

¹⁰³Followell, 32.

¹⁰⁴Youdim., loc. 4733.

¹⁰⁵D. Garfield Davies and Anthony F. Jahn, *Care of the Professional Voice*, 2nd ed., (New York: Rutledge, 2005), 97.

¹⁰⁶Sataloff, "Care of the Professional Voice," in *Textbook of Performing Arts Medicine*, 239-240.

¹⁰⁷Bunch, 124.

¹⁰⁸Dahlia M. Sataloff and Robert Thayer Sataloff, "Obesity and the Professional Singer," 105.

¹⁰⁹Ory Brown, "Little Black Dress, Part 2: A Singer's Perspective on Bariatric Surgery," in *The Singer's Guide to Complete Health*, Anthony F. Jahn, ed., (Oxford: Oxford University Press, 2013), 181-185.

Brown details the sacrifices that she made, including struggles with dehydration, changes in diet, vitamin and mineral supplementation, and particularly, the adjustments she had to make to her singing voice:

My support mechanism had to be reinvented. For my whole singing life, when I took in a breath the sheer weight of my abdomen assisted me in supporting the voice. I had the support of all that extra weight keeping the abdomen from collapsing during the exhalation. As my body changed I began to sing “off the voice” and had severe support issues. It is a challenge that can be overcome, but it is something that has to be dealt with.¹¹⁰

Brown also recommends working on the psychological issues that may be connected with overeating, and finding a bariatric surgeon who has experience working with singers.¹¹¹

Primary issues with bariatric surgery for singers include rapid weight loss, which can affect abdominal support; calorie restrictions that can cause feelings of fatigue; and the need to relearn one’s breath support system. As a significant amount of weight loss happens in the first few weeks after bariatric surgery, the body may have changed rapidly before a singer is physically able to begin singing again. This leads to a period of time in which singers must relearn how their breath support works. In slower forms of weight loss, a singer is able to continue practicing during the weight loss, and so any vocal adjustments can be made almost unconsciously. However, vocal concerns must sometimes be secondary to concerns of overall health and longevity; thus, if bariatric surgery is recommended to a singer, it is worthwhile to weigh carefully all risks and benefits.

Additional Concerns: Anesthesia

Careful delivery of anesthesia is a common concern for singers undergoing a variety of surgeries, as general anesthesia can interfere with various aspects of the vocal

¹¹⁰Brown, 183.

¹¹¹Ibid, 184.

mechanism.¹¹² Some of the risks of intubation include mild sore throat, rough or raspy quality to the voice, diminished vocal range, increased voice breaks, mild globus sensation, and increased throat clearing.¹¹³ Most of these effects diminish within 72 hours after surgery, but there is a slight risk of complications including possible permanent vocal damage.¹¹⁴ Therefore, it is imperative that a singer undergoing bariatric surgery (or any other surgery that involves anesthesia delivered via intubation) consult with their anesthesiologist prior to surgery. The singer should request the smallest tube and lowest cuff pressure that are safe to use. Additionally, Meacham and Schindler recommend careful extubation, preferably before the singer emerges fully from the anesthesia.¹¹⁵ Muscle relaxants with paralytic agents may be used to prevent bucking during tube removal, and a follow-up visit with an otolaryngologist is recommended, particularly if voice issues persist after surgery.¹¹⁶ Another possible option, if the surgery does not involve the mouth or throat, is the use of the laryngeal mask. The laryngeal mask sits on top of the larynx, and although it is not risk-free, it can be a helpful tool if the anesthesiologist is experienced in its use.¹¹⁷ The anesthesiologist is tasked with keeping a patient sedated and breathing during surgery, but an experienced anesthesiologist will be able to do this task while keeping a singer's vocal well-being in mind.

Slow and Steady Weight Loss

Slow and steady weight loss (no more than 2-3 pounds per week) is the method most recommended by physicians and other health professionals to any overweight or

¹¹²Ryan K. Meacham and Joshua Schindler, "Anesthesia Care for the Professional Singer," *Anesthesiology Clinics* 33 (2015): 347, <http://dx.doi.org/10.1016/j.anclin.2015.02.012> (accessed September 22, 2016).

¹¹³Meacham and Schindler, 348-349.

¹¹⁴Ibid., 349.

¹¹⁵Ibid., 351.

¹¹⁶Ibid., 353.

¹¹⁷Jahn, 214.

obese person.¹¹⁸ This recommendation is perhaps even more important for singers, for whom rapid changes in the body can create problems with the voice.¹¹⁹ Even a small degree of obesity can have negative effects on ease of vocal production,¹²⁰ so it is worthwhile to begin a weight-loss program as quickly as possible. The sooner overweight people begin to make lifestyle changes to fight against obesity, the better the results they are likely to have.¹²¹ A reduction of as little as 5-10% of a person's current body weight can significantly lessen the prevalence of comorbidities such as diabetes or risk of heart disease.¹²² There are many programs with documented success in helping people lose weight, but a plan that balances proper nutrition and exercise is an excellent starting point, and may be sufficient for many people wishing to reduce their weight.¹²³ If a singer is going to embark on a weight loss plan, this plan should be discussed with their physician, and care should be taken to monitor overall physical function as well as vocal function.¹²⁴ Some clinically researched weight-loss plans and strategies for their implementation are discussed in Chapter 4.

Fasting

Fasting as a means of inducing weight loss has received mixed reviews at best,¹²⁵ but the effects of fasting on the voice are important to note, particularly for singers who may engage in extended fasting for religious purposes. A study published by Hamdan,

¹¹⁸Vanek, 50.

¹¹⁹Sataloff, *Vocal Health and Pedagogy*, 84.

¹²⁰Dahlia Sataloff and Robert Thayer Sataloff, "Obesity and the Professional Singer," 107.

¹²¹Roslin, 172.

¹²²Jensen et al., S118.

¹²³Ibid., S122.

¹²⁴Sataloff, *Textbook of Performing Arts Medicine*, 239-240.

¹²⁵Alex Johnstone, "Fasting for Weight Loss: An Effective Strategy or Latest Dieting Trend?" *International Journal of Obesity* 39 (2015): 727(-733), doi:10.1038/ijo.2014.214.

Sibai, and Rameh investigated these effects in 28 female subjects.¹²⁶ All subjects were free of voice issues and had not had any laryngeal surgeries. Subjects were evaluated before fasting and after the first week of Ramadan, when the women would abstain from all food and liquids from sunrise to sunset, a minimum of 14 hours. The authors reported that 23 of the 28 subjects had an increase in phonatory effort after fasting,¹²⁷ and more than half of the subjects described experiencing vocal fatigue as well.¹²⁸ Dehydration appeared to be a major factor in the increase in phonatory effort.¹²⁹ Maximum phonation time was the only acoustic factor that was found to be statistically significant, and the study reported an average decrease in MPT of more than two seconds.¹³⁰ Overall, it was determined that fasting does have an effect on the voice, mostly in terms of an increase in phonatory effort and reduction in MPT, which are likely connected to dehydration and elements of muscular fatigue.¹³¹

Chapter Summary

Bariatric surgery has been steadily increasing in popularity as an effective way for highly obese people to lose weight and regain more control over their health,¹³² but singers should be cautious when pursuing this option, as no studies currently exist that present a clear picture of the long-term effects of surgery on a singer's health and vocal function. Recovery from bariatric surgery requires a complete lifestyle change, which may prove difficult to maintain. The possibility of permanent vocal change is small, but significant, and the rapid weight loss will lead to some challenges in figuring out breath

¹²⁶Abdul-Latif Hamdan, Alba Sibai, and Charbel Rameh, "Effect of Fasting on Voice in Women," *Journal of Voice* (21/4, 2007) 495-501.

¹²⁷Hamdan, Sibai, and Rameh, 495.

¹²⁸Ibid, 497.

¹²⁹Ibid, 498.

¹³⁰Ibid., 499. Table 3.

¹³¹Ibid., 499.

¹³²Mechanick et al., 339.

support and stamina. Weight loss that is attained through diet and exercise may be more challenging initially, but has fewer potential causes for concern, and requires no interruptions in practice or performance schedules. Ultimately, the singer's overall health must be the primary factor in determining what steps regarding weight loss should be taken.

Chapter 4 - Nutrition and Diet

What singers choose to eat and drink can play a great role in overall physical health, just as these choices affect the general populace.¹³³ The itinerant lifestyle of the professional singer lends itself to particular pitfalls that require careful assessment from a nutritional standpoint.¹³⁴ Because diet (meaning the full spectrum of food and drink that a person chooses to ingest) is a key contributor to a person's overall health, changes in diet can bring about more rapid changes in physique than exercise alone.¹³⁵ This chapter begins with a discussion of nutritional challenges that are particular to singers, general tenets of good nutrition, some weight-loss plans that embrace the tenets of good nutrition, and closes with some information on nutrition education. Research indicates that singers often consult with their vocal teachers and coaches for information on medications, foods, and drinks,^{136,137} so it is of utmost importance that those professionals seek out evidence-based research to supplement their knowledge and refer their students to nutritionists and medical professionals as needed. Slover and Dwyer reference a particular instance of the extremity of the relationship and the trust that students have for their teachers regarding medical advice:

¹³³Isobel Contento, "Review of Nutrition Education Research in the *Journal of Nutrition Education and Behavior*, 1998 to 2007," *Journal of Nutrition Education and Behavior* 40/6 (Nov./Dec. 2008): 331.

¹³⁴Angela N. Slover and Johanna T. Dwyer, "Professional Singers with Obesity or Eating-Related Problems: The Diva Syndrome," *Nutrition Today*, 30/3 (May/June 1995): 127

¹³⁵Julie Schwartz, "Nutritional Therapy," *Primary Care: Clinics in Office Practice* 43/1 (Mar. 2016): 70, accessed Jan. 22, 2017, doi: 10.1016/j.pop.2015.08.012.

¹³⁶Slover and Dwyer, 125.

¹³⁷Brian E. Petty, "Health Information-Seeking Behaviors Among Classically Trained Singers," *Journal of Voice* 26/3 (May 2012): 331.

One singer reported that when she had a temperature of 103° her teacher counseled her to exercise until she worked up a sweat and then wrap up in a blanket, take Nyquil at bedtime, buy a specific throat lozenge, and abstain from taking antihistamines. After finally seeing a physician, she called to cancel her voice lesson, but her voice teacher insisted she come to her lesson anyway.¹³⁸

Nutrition Pitfalls: The “Diva Syndrome”

The Diva Syndrome is the name given to a particular, flawed set of eating and lifestyle behaviors that are prevalent in professional singers.¹³⁹ These behaviors include going out after performances for large meals, dependence on fast food, and irregular eating habits and specialized food rituals. Casting aside any judgements of the syndrome’s name, careful evaluation of the Diva Syndrome affirms that performers are particularly susceptible to these negative behaviors. Performance days create special nutrition challenges. Many singers believe that a full stomach can interfere with their breath support, so they do not eat for a set period of time before a performance. By the time the opera or concert is over, as many as seven or eight hours may have elapsed since the singer last ate, leading to strong feelings of hunger. Going out for food (and often, drinks) after a performance is a common social ritual among performers, and the late hours mean healthy food choices are less likely to be an option. Additionally, overeating is very easy due to hunger from fasting before and through the performance.¹⁴⁰ Late-night heavy eating can also contribute to gastroesophageal reflux disease (GERD), as lying down after eating is considered a potential trigger for GERD.¹⁴¹

¹³⁸Slover and Dwyer, 125.

¹³⁹Slover and Dwyer, 124.

¹⁴⁰Zarabi, 141-142.

¹⁴¹Ingo R. Titze and Katherine Verdolini Abbott. *Vocology: The Science and Practice of Voice Habilitation* (Salt Lake City: National Center for Voice and Speech, 2012), 79.

Professional singers, particularly in the opera world, are often expected to attend donor parties and other events that center around food and drink.¹⁴² Many singers also have day jobs, leaving little time for meal preparation, and often making singers reliant on fast foods and other pre-prepared meals in the rush to get from work to rehearsal and back again.

Nutrition Pitfalls: Food Myths and Taboos

Food myths and taboos also play a significant role in a singer's nutritional status.¹⁴³ Many singers profess a belief that certain foods, such as dairy, will impede a performance by producing phlegm, or that eating a particular meal is absolutely necessary to have a good performance. In order to elucidate the issue of singers' nutritional habits, a short sampling of evidence follows. This anecdotal information was pulled from published singer interviews, and biographies of established performing artists.

Pavarotti was known to eat pasta with butter and cheese promptly two hours before going onstage.¹⁴⁴ Caruso described his typical performance day eating habits in his book, *How to Sing*: "On the nights when I sing I take nothing after luncheon [usually around 2pm], except perhaps a sandwich and a glass of Chianti, until after the performance, when I have a supper of whatever I fancy within reasonable bounds."¹⁴⁵ It is interesting to note that contradictions abound in what singers choose to eat and drink pre-performance. The quotation from Caruso mentions a glass of wine before a performance, but other singers, such as soprano Martina Arroyo, say they cannot drink

¹⁴²Slover and Dwyer, 125.

¹⁴³Ibid.

¹⁴⁴Marcia Lewis, *The Private Lives of the Three Tenors* (Secaucus, NJ: Birch Lane Press, 1996), 148.

¹⁴⁵Enrico Caruso, *How to Sing* (Brooklyn, NY: The Opera Box, 1973), 16.

and sing.¹⁴⁶ Additionally, many singers avoid eating any food for a set time before a performance, but baritone Sherrill Milnes stated: “I eat as close to the performance as possible, and as much food as I can put away, steak, potatoes and salad. If I don’t eat well I begin to feel weak during the performance. I don’t know why this is, but I just sing better on a full stomach.”¹⁴⁷ Bass Jerome Hines recalled a production of *La Boheme* in which, as part of a character choice, he ate “one and a half chickens, five salami sandwiches, and Mimi’s ice cream between my singing cues” in Act II.¹⁴⁸ Many other anecdotes and examples of singers’ nutritional choices can be found in both the books mentioned in this document, as well as numerous other accounts of singers’ lives. The vast variety of methods in pre-performance habits among these respected singers demonstrates the need for singers to determine their own nutritional needs, and find methods that work for them, rather than being swayed by popular advice.

Rituals and superstitions also abound during times of sickness, such as the drinking of hot tea or use/avoidance of particular medications. Although singers can benefit from knowing the research on medications, especially as many of them can have side effects which can dry out the vocal folds, good hydration and rest will often alleviate the worst of these symptoms. Singers frequently look to their teachers and coaches for advice, even before seeking medical attention,¹⁴⁹ so it is imperative that these individuals educate themselves as to the truth of the myths they support, and refer their students to medical professionals as needed. Teachers and coaches can also encourage the singers they work

¹⁴⁶Jerome Hines, *Great Singers on Great Singing* (Garden City, NY: Doubleday & Co., 1982), 31.

¹⁴⁷Alan Blackwood, *The Performing World of the Singer* (London: Hamish Hamilton, 1981), 49.

¹⁴⁸Hines, 213.

¹⁴⁹Slover and Dwyer, 125.

with to evaluate their behaviors toward food and determine for themselves if their habits are actually producing any benefit to the singer.

Ways to Address Diva Syndrome

If a singer finds they are struggling with aspects of Diva Syndrome, or other nutritional difficulties, Slover and Dwyer do offer some practical suggestions. First, bring a small snack to the venue to eat immediately after a performance. A healthy snack can alleviate some of the extreme post-performance hunger and enable a singer to make either a better food choice, or potentially avoid overeating at post-performance gatherings. Second, make specific, individual plans for handling performance days, off-days, and sick days, as each brings its own set of challenges. Finally, singers should be educated early in their training about the risk of obesity as a professional hazard in a singing career, as preventing obesity is easier than treating it.¹⁵⁰

Nutrition and Diets

For singers who wish to lose weight, or simply change their eating habits, it can be easy to become overwhelmed by the sheer volume of available options. Although losing weight rapidly can create potential vocal concerns,¹⁵¹ the temptation of fad diets and other, possibly medically unsafe, options can seem appealing. However, research shows that weight lost rapidly from a fad diet is often quickly regained.¹⁵² The medical community has spent decades researching various diets in hopes of finding a one-size-fits-all diet that can successfully accomplish long-term weight loss, but thus far has determined that dietary adherence plays a larger role than any specific type of diet over

¹⁵⁰Ibid., 127.

¹⁵¹Sataloff, *Vocal Health and Pedagogy*, 1998, 84.

¹⁵²Schwartz, 72.

time.^{153,154,155} The 2013 Guidelines for the Management of Overweight and Obesity in Adults, a joint publication from the American Heart Association, American College of Cardiology, and The Obesity Society¹⁵⁶ demonstrates through a thorough literature review and meta-analysis that a myriad of diets can be effective in promoting weight loss, as long as an energy deficit (measured in kilocalories per day) can be realized. Studies are summarized, and research is presented in easy-to-read charts ranked by the strength of the evidence available in each area. Because of the many available options and limited scope of this document, only a small sample of these diets are discussed in this chapter. Diets were selected due to a combination of their likely familiarity to the intended reader, and the prevalence of the diet's use in research literature with successful outcomes. A variety of diets are included to give the reader some possible options or starting points for diet, as adherence, or ability to stay with a diet long-term, has been shown to be a greater predictor of weight-loss success.¹⁵⁷ These diets represent four of the major categories of diet: 1) Restricted calorie - Weight Watchers; 2) Dietary pattern change - DASH diet; 3) Macronutrient balance/higher protein - Zone diet; 4) High protein, low carbohydrate diet - Atkins.

¹⁵³Michael L. Dansinger, et al., "Comparison of the Atkins, Ornish, Weight Watchers, and Zone Diets for Weight Loss and Heart Disease Risk Reduction: A Randomized Trial," *Journal of the American Medical Association* 293/1 (January 2005): 49, doi:10.1001/jama.293.1.43 (accessed Jan 23, 2017).

¹⁵⁴Gareth R. Dutton, Melissa H. Laitner, and Michael G. Perri, "Lifestyle Interventions for Cardiovascular Disease Risk Reduction: A Systematic Review of the Effects of Diet Composition, Food Provision, and Treatment Modality on Weight Loss," *Current Atherosclerosis Reports*. 16/442 (2014), 12, doi: 10.1007/s11883-014-0442-0 (accessed Jan. 23, 2017).

¹⁵⁵Celeste E. Naude et al., "Low Carbohydrate Versus Isoenergetic Balanced Diets for Reducing Weight and Cardiovascular Risk: A Systematic Review and Meta-Analysis," *PLoS ONE*, 9/7 (2014): e100652, 1, doi: 10.1371/journal.pone.0100652 (accessed January 23, 2017).

¹⁵⁶Jensen et al., S120.

¹⁵⁷Schwartz, 74.

Weight Watchers

Weight Watchers began in the 1960's and is now a multi-billion dollar company.¹⁵⁸ Rather than basing intake on calories, Weight Watchers' SmartPoints program assigns a points value to foods and beverages, and participants are allotted a certain number of points per day, depending on current weight and weight-loss goals.¹⁵⁹ Traditionally, Weight Watchers was based around weekly, in-person meetings facilitated by Leaders who have successfully lost weight through the program. Although these meetings still exist, they are now just one option for the Weight Watchers plan, which includes an online-only component, online content plus weekly meetings, or the addition of one-on-one coaching for personalized attention. Each of these plans has a different fee scale, with the online-only plan being the least expensive.¹⁶⁰ Weight Watchers has been praised for being one of a few commercial diet options that is based on "long-standing medical advice and recommended restriction of portion sizes and calories,"¹⁶¹ and the fact that it combines diet with behavioral counseling.¹⁶² Because of the points system, no single food or food groups are excluded, which could make this diet an appealing option for a singer who may need to attend events where food and drink are served.

DASH Diet

The DASH, or Dietary Approaches to Stop Hypertension, diet was developed through research and designed to lower blood pressure; however, it has proven to also assist in weight loss. It is a plant-based diet that emphasizes fruits, vegetables, and low-

¹⁵⁸Weight Watchers International, Inc., "Form 10-K," <http://www.weightwatchersinternational.com/Cache/35299026.pdf> (accessed January 25, 2017).

¹⁵⁹Dansinger et al., 45.

¹⁶⁰Weight Watchers International, Inc., "Home Page," <https://www.weightwatchers.com/us/> (accessed Jan. 25, 2017).

¹⁶¹Dansinger et al., 43.

¹⁶²Kelly D. Brownell and Thomas A. Wadden, "The Heterogeneity of Obesity: Fitting Treatments to Individuals," *Behavior Therapy* 22 (1991): 167.

or non-fat dairy, but it also includes lean proteins such as fish and poultry and whole grains.¹⁶³ The DASH diet has been described as similar in style to the Mediterranean diet, which has been clinically shown to assist in weight loss, if the required energy deficit is met.¹⁶⁴ This diet emphasizes meal planning, but still allows for a great variety of foods, so maintenance is less of an issue than in other, highly-restrictive diets. However, challenges may occur in scenarios where a singer is dining out with friends or attending special events.

Zone Diet

The ZoneTM diet is a lower carbohydrate, macronutrient-focused diet that was developed by Dr. Barry Sears. It claims to reduce “diet-induced inflammation,” which is not defined on the website, but listed causes include excess intake of saturated fatty acids, excess omega-6 fatty acids, and insufficient omega-3 fatty acids, along with some additional causes.¹⁶⁵ The Zone plan is also called the 40/30/30 plan, as 40% of one’s daily calories should come from carbohydrates, 30% from lean proteins, and 30% from fat. Emphasis is placed on using fruits and vegetables as the principal sources of carbohydrates.¹⁶⁶ At each meal, dieters following this plan should fill one-third of their plates with lean protein, two-thirds with carbohydrates such as fruits and non-starchy vegetables, and add a small amount of fat, preferably monounsaturated fat.¹⁶⁷ The diet’s website makes some bold claims about results, including “dramatic” reductions in disease

¹⁶³Marla Heller, “What is the DASH Diet?” http://dashdiet.org/what_is_the_dash_diet.asp, (accessed January 27, 2017).

¹⁶⁴Jensen et al., S120.

¹⁶⁵Zone Labs, Inc., “What Is the Zone Diet?” <http://www.zonediet.com/the-zone-diet/> (accessed January 26, 2017).

¹⁶⁶Samuel N. Cheuvront, “The Zone Diet Phenomenon: A Closer Look at the Science Behind the Claims,” *Journal of the American College of Nutrition* 22 (2003): 9.

¹⁶⁷Zone Labs, Inc., “How the Zone Diet Works,” <http://www.zonediet.com/the-zone-diet/how-the-zone-diet-works/> (accessed Jan. 26, 2017).

risk,¹⁶⁸ but independent studies have not confirmed that the Zone diet is any more effective than other diets for weight and health risk reduction.¹⁶⁹ However, it is presented in this document because research has indicated it can be an effective diet if it fits a person's needs and lifestyle requirements.¹⁷⁰ Because the Zone diet focuses more on proportions and broad macronutrient categories, it may be a good choice for a singer who does not want to count calories or eliminate any specific food or food groups.

Atkins Diet

The Atkins Diet is a very low carbohydrate diet that emphasizes the use of protein and fat instead of carbohydrates. Two versions of the diet exist, the Atkins20TM and the Atkins 40TM. The original plan (Atkins20) limits a person to no more than 20 grams of carbohydrates per day.¹⁷¹ As a reference, one slice of white bread has about 15 grams of carbs, while one serving of spaghetti has more than 40 grams of carbs. As weight loss nears a person's goal weight, carbohydrates are slowly added back into the diet for maintenance. The Atkins diet is the most extreme of the diets described in this document. While it has been clinically proven to promote weight loss,¹⁷² researchers question whether low-carbohydrate diets may have serious long-term health consequences. Of particular concern are the restrictions on fruit and vegetable intake, as well as the increase of saturated fat that might occur with higher protein intake.¹⁷³ Because increased saturated fat consumption may lead to higher cholesterol levels and amplify the risk of

¹⁶⁸Zone Labs, Inc., <http://www.zonediet.com/the-zone-diet/>

¹⁶⁹Dansinger et al, 51.

¹⁷⁰Jensen et al., S120.

¹⁷¹Atkins Nutritionals, Inc., "The Benefits of a Low-Carb Diet: How Does Atkins Work?" <https://www.atkins.com/how-it-works> (accessed January 25, 2017).

¹⁷²Jensen et al., S120.

¹⁷³Naude et al., 2.

cardiovascular disease,¹⁷⁴ the Atkins diet may not be the best choice for a person with high risk of heart disease.¹⁷⁵ Additionally, multiple studies report that weight loss by means of a low carbohydrate diet is effectively no different than other diets that provide the necessary energy reduction for weight loss.^{176, 177, 178} Because of the severity of the restrictions in the Atkins diet, prolonged adherence might be overly difficult to sustain for a singer with a busy schedule; however, dietary adherence heavily depends on the individual,¹⁷⁹ and Atkins is certainly a clinically valid option.

Nutrition and Technology

Although the increased use and availability of technology in today's society is sometimes blamed for a more sedentary lifestyle, which adversely affects the rising obesity rates, technology is being leveraged as a way to combat obesity and other health issues. Mobile Health, or mHealth, refers to the use of mobile and other wireless devices "to affect health outcomes, health care services, and health research."¹⁸⁰ The quick adoption of smartphone technology and the use of mobile applications, or apps, has led to the rapid development of a vast number of health and fitness apps. Unfortunately, due to the rapid pace of technological development versus the slower pace of medical research, no studies have yet emerged that have fully vetted or evaluated mHealth apps by rigorous

¹⁷⁴American Heart Association, "Saturated Fats," http://www.heart.org/HEARTORG/HealthyLiving/HealthyEating/Nutrition/Saturated-Fats_UCM_301110_Article.jsp#.WI-bZrYrI_U (accessed February 3, 2017).

¹⁷⁵Anne Brown, "Metabolic Syndrome," *Patient Care*, February 2004, 14+. Academic OneFile (accessed January 23, 2017), http://access.library.miami.edu/login?url=http://go.galegroup.com.access.library.miami.edu/ps/i.do?p=AO NE&sw=w&u=miami_richter&v=2.1&it=r&id=GALE%7CA114243777&asid=bec4ca1b790197707743272de4d45d4d.

¹⁷⁶Naude et al., 14.

¹⁷⁷Dutton et al., 10.

¹⁷⁸Dansinger et al., 51.

¹⁷⁹Schwartz, 74.

¹⁸⁰Melanie Hingle and Heather Patrick, "There are Thousands of Apps for That: Navigating Mobile Technology for Nutrition Education and Behavior," *Journal of Nutrition Education and Behavior* 48/3 (2016): 213.

clinical standards.¹⁸¹ However, a number of peer-reviewed reports and evaluation criteria have emerged, and these resources may be useful in directing a person toward apps that may be beneficial and have elements derived from evidence-based medicine.¹⁸² Similarly to the previous section on diets, this section lists ways in which mHealth apps can be advantageous to the singer, and describes a small selection of apps that have large user bases and have been referenced numerous times in the literature.

The Usefulness of mHealth Apps

Health and fitness apps may help singers (and others in the general populations) create desired dietary changes and assist in making healthier food choices.¹⁸³ Many health apps have a focus toward weight loss, and activities such as logging foods eaten, tracking one's weight, and tracking physical activity have been shown to lead to increased weight loss.¹⁸⁴ Studies suggest that complying at least seventy-five percent of the time by recording foods eaten will likely lead to weight loss;¹⁸⁵ additionally, those who use apps to record their food intake have been more successful than those who use paper to record their food choices.¹⁸⁶ As many of these apps are free, mHealth apps are often touted as a means for populations with either limited access to healthcare or limited financial resources to receive information and motivation for behavioral change.^{187,188}

Due to frequent travel, and the high cost of healthcare, many singers could fit into one of

¹⁸¹L. Ann Gilmore et al., "The Technology Boom: A New Era in Obesity Management," *Journal of Diabetes Science and Technology* 8/3 (2014): 605, DOI: 10.1177/1932296814525189.

¹⁸²John P. Higgins, "Smartphone Applications for Patients' Health and Fitness," *The American Journal of Medicine* 129/1 (January 2016): 13-15.

¹⁸³*Ibid.*, 11.

¹⁸⁴Arya Pourzanjani, Tom Quisel, and Luca Foschini, "Adherent Use of Digital Health Trackers Is Associated with Weight Loss," *PLoS ONE* 11/4 (2016): 6, doi:10.1371/journal.pone.0152504.

¹⁸⁵Gilmore et al., 598.

¹⁸⁶Higgins, 13.

¹⁸⁷*Ibid.*, 19.

¹⁸⁸Gilmore et al., 603.

the previous categories.¹⁸⁹ Health and fitness apps number in the tens of thousands, but this document will highlight two of the most popular in usage that are also prevalent in current research literature.

MyFitnessPal

MyFitness Pal first appeared as a website in 2005, and the iPhone app launched in December of 2009, making it one of the earliest available health and fitness apps.¹⁹⁰ MyFitnessPal includes a calorie tracker, and the ability to input various exercises to monitor net calorie intake. The food tracker includes a barcode scanner, allows users to input their own recipes, and remembers frequently eaten foods and maintains those in a short list by meal category to reduce input time. The app also tracks a food's major nutrients (or "macros"), such as fat, protein, and carbohydrates, as well as its content of sugar, fiber, cholesterol, and some vitamins.¹⁹¹ Like many current health and fitness apps, MyFitnessPal can synchronize with additional health and activity apps, such as RunKeeper, Fitbit, or MapMyFitness. MyFitnessPal is free, although there is a premium version that tracks more nutrients and offers more daily variations in goal setting within an ad-free environment. Both the free and premium versions link to the MyFitnessPal blog, which contains a variety of posts about diet, exercise, and overall health and wellness. MyFitnessPal received high rankings in a 2012 Consumer Reports survey, gaining higher ratings and satisfaction scores than Weight Watchers.¹⁹²

¹⁸⁹Cazden, loc 1101.

¹⁹⁰Richard MacManus, "How MyFitnessPal Became the King of Diet Trackers," <http://readwrite.com/2015/02/23/trackers-myfitnesspal-excerpt/> (accessed Feb. 3, 2017).

¹⁹¹Higgins, 14.

¹⁹²Sherry Pagoda and Gary G. Bennett, "How Behavioral Science Can Advance Digital Health," *Translational Behavioral Medicine* 3 (2013): 272, doi: 10.1007/s13142-013-0234-z.

LoseIt!

LoseIt! is another popular health and fitness app with a focus on calorie tracking. In the free version of the app, a person can track their weight, steps, and exercise calories, in addition to food tracking. The LoseIt! app includes a barcode scanner and extensive food database, like MyFitnessPal, and can synchronize with various activity trackers and other apps, such as Fitbit, Nike+, and RunKeeper. In September 2016, LoseIt! launched SnapIt!, a feature that allows users to take a photo of their food. The app analyzes the photo, and offers suggestions that can be logged. This method of recording nutritional components of food eaten by taking photographs of them has been tested in previous studies, and validated as an accurate way to report energy intake,¹⁹³ but LoseIt! is the first commercially successful app to implement the technology. SnapIt! is available as a feature in the LoseIt! app, but it is listed as still being in beta testing as of January 2017. However, this feature appears to be a tremendous step forward in easing the burden of food tracking. Other mHealth apps will likely be working to incorporate this feature in the near future.

Nutrition and the Singer

A healthy, balanced diet can benefit everyone, but especially singers, who are often considered to be “vocal athletes.”¹⁹⁴ Unfortunately, singer-specific research on diet and nutrition lags well behind research for traditional athletes and even the general populace. Nutritionists recommend that all singers, regardless of health status (i.e., not only whether one is sick, but whether one is at a healthy weight or needs to make changes) can benefit

¹⁹³Gilmore et al., 605.

¹⁹⁴Pamela L. Harvey and Susan H. Miller, “Nutrition and the Professional Voice,” in *Vocal Health and Pedagogy*, ed. Robert T. Sataloff (San Diego, CA: Plural Publishing, 2006): 99.

from taking greater control over their own nutritional habits.¹⁹⁵ Therefore, this document includes nutritionist-approved resources for singers who wish to educate themselves about nutrition, and make their own informed choices. Many readers may recall the USDA Food Guide Pyramid, which was released in 1992.¹⁹⁶ Because it was based only on theory, rather than being subjected to rigorous testing, many nutritionists had concerns with the validity of the Food Guide Pyramid as a nutrition education resource.¹⁹⁷ As research was conducted, corresponding changes were made to the Food Pyramid. In 2005, MyPyramid was introduced. MyPyramid, unlike the Food Guide Pyramid, developed in recognition that no one approach to diet will work for every person. Plus, for the first time, movement and physical activity became an official part of the USDA's recommendations.¹⁹⁸ In June 2011, MyPlate replaced MyPyramid. MyPlate and its companion resource, ChooseMyPlate.gov, provide dietary recommendations via the visual of a place setting.¹⁹⁹ MyPlate is based on the 2015-2020 *Dietary Guidelines for Americans*. The *Dietary Guidelines* are published every five years and are based on current scientific and medical knowledge. These guidelines form the foundation of federal nutrition policy and nutrition education.²⁰⁰ The USDA also hosts a website feature known as SuperTracker, which allows for the implementation of diet and activity tracking via the SuperTracker website.

¹⁹⁵Ibid.

¹⁹⁶United States Department of Agriculture Center for Nutrition Policy and Promotion, "Food Guide Pyramid," <https://www.cnpp.usda.gov/FGP> (accessed Feb. 3, 2017).

¹⁹⁷Harvey & Miller, 100.

¹⁹⁸United States Department of Agriculture Center for Nutrition Policy and Promotion, "Anatomy of MyPyramid," https://www.cnpp.usda.gov/sites/default/files/archived_projects/MyPyramid_Anatomy.pdf (accessed Feb. 3, 2017).

¹⁹⁹United States Department of Agriculture Center for Nutrition Policy and Promotion, "MyPlate/MiPlato," <https://www.cnpp.usda.gov/MyPlate> (accessed Feb. 3, 2017).

²⁰⁰United States Department of Agriculture Center for Nutrition Policy and Promotion, "Dietary Guidelines," <https://www.cnpp.usda.gov/dietary-guidelines> (accessed Feb. 3, 2017).

Regardless of the method or methods singers use to monitor their nutrition, following a healthy eating plan offers myriad benefits, including weight management, increase in energy levels, and reduction of food cravings.²⁰¹ Additionally, long-term nutritional health is less about avoiding “bad” foods, and more about making healthy, sustainable choices.²⁰² Harvey and Miller suggest that singers, after consultation with medical professionals, should determine and then write down specific, measurable nutrition goals, such as eating 25-30 grams of fiber daily, or checking the nutritional facts panels on packaged foods. Daily vitamin and mineral supplementation may also assist singers who have difficulty reaching recommended daily levels of certain nutrients.²⁰³

Chapter Conclusions

Ultimately, singers, as adults, are responsible for their own nutritional choices. Although consultation with a medical professional or registered dietician/nutritionist is encouraged before implementing dietary changes, the abundant variety of apps and online resources make obtaining information about healthy food choices much easier. However, mobile applications are not subjected to rigorous testing or clinical trials, and are not designed to be used for diagnosis or to prescribe treatment.²⁰⁴ Numerous nutritional studies agree that many diets can produce weight loss, if an energy deficit is created; therefore, there is no need for singers to rely on fad diets or other questionable weight loss schemes. Changing one’s nutritional habits, like changing any habit, takes time and

²⁰¹Harvey and Miller, 106.

²⁰²Ibid., 107.

²⁰³Ibid., 108.

²⁰⁴Harvard Health Publications, “Some Computer Downloads for Better Health Should Be Avoided,” 2013, 1.

effort, but the end result leads to better physical health, which is inseparable from vocal health.²⁰⁵

²⁰⁵Harvey and Miller, 99.

Chapter 5: Discussion and Conclusions

Obesity is a concern not only of classical singers, but the general populace as well. As obesity rates continue to rise, singers should be mindful of their health and nutrition habits, and how these habits affect their bodies. This collection of literature on obesity, weight loss, and vocal function, as well as nutritional concerns of singers, provides evidence-based information to singers and voice teachers who wish to maintain appropriate control of their physical health. Physical health and vocal health have a symbiotic relationship, and current research indicates that obesity, which contributes to health concerns such as cardiovascular disease and type II diabetes, has no provable benefit to a singer.

Summary of the Study

This DMA Essay is a collection of the literature available regarding body weight, particularly obesity, nutrition, and vocal function. Additional attention was given to the concerns of classical singers. The essay sought to answer questions regarding how being overweight or obese may affect vocal production; how significant weight loss, particularly through bariatric surgery, may affect vocal production; and to address factors specific to performers' lives that may lead to obesity; plus, provide evidence-based recommendations from medical professionals and nutritionists for singers who wish to lose weight or otherwise make dietary changes. The format of a literature review was chosen as no previous collection of such information could be found, and a literature review was deemed the most efficient manner for the collection and promotion of this information to the community of classical singers and their teachers.

Major Findings

Obesity carries with it a number of health risks, such as increased likelihood of coronary heart disease, type II diabetes, hypertension, sleep apnea, and more.²⁰⁶ Many singers are likely cognizant of these general health risks of obesity, but singers may be largely unaware of the potential hindrances obesity presents to efficient vocal function. More studies with larger sample sizes need to be conducted before evidence can be deemed conclusive, but trends from the studies evaluated in this document are certainly observable.

One major finding involves the inhibition of the respiratory system. Excess abdominal or visceral fat hinders efficient respiration. Evidence for this hindrance is measured with the increased subglottic pressures required for obese study participants to bring the vocal folds into oscillation^{207,208} and the reduction of phonation threshold pressure (PTP) as reported by Solomon et al. with weight loss.²⁰⁹ Doctors who treat singers suggest their vocal prowess may have been achieved in spite of obesity,²¹⁰ and this statement is supported by clinical findings that indicate a reduction in PTP without clinical differences in voice evaluation in people who have lost weight. Thus, while the voice may not differ perceptually or acoustically, phonation itself may be easier with a reduction in overall body mass.²¹¹ Maximum phonation time also appears to be reduced with obesity, but larger sample sizes in trials are needed to confirm this hypothesis.

²⁰⁶WHO, 39.

²⁰⁷Celebi et al., 989.

²⁰⁸Solomon et al., 39.

²⁰⁹Ibid.

²¹⁰Roslin, 167.

²¹¹Solomon et al., 41.

Another finding relates to rapid weight loss and vocal concerns. Although no clinical differences were perceived in the vocal assessment in the two existing studies that evaluate vocal function after bariatric surgery, Hamdan et al.'s study reported patients who had self-perceived changes in the voice. Three of the nine patients in that study self-reported vocal changes such as increase in phonatory effort and fatigue which were not corroborated clinically. These patients were not singers, but it is likely that singers, who are generally very sensitive to slight vocal changes, may experience negative effects. As this study only followed patients short-term, (six months post-operatively), it cannot be determined whether these effects are lasting, or if they might stabilize when the weight loss stabilizes (usually 12-18 months post-operatively). From the limited personal reports of singers who have undergone bariatric surgery, it is evident that some time spent re-learning the vocal mechanism, particularly breath support, is necessary.²¹² When singers choose to undergo bariatric surgery, they should be informed about the physical and nutritional changes required, and understand the length of time required for healing and what bodily changes to expect before they are allowed to begin singing again.

Nutritional concerns of singers is the area perhaps least explored clinically. The need to address the problem created by traditional performance schedules, which often leaves singers ravenously hungry after their evening performances, has been observed and reported, but no methods of addressing this issue have yet been tried. Additionally, mythos surrounding food and drink abounds, with little medical correlation.²¹³ However, there is proliferate research regarding nutrition and dietary advice for the general

²¹²Brown, 183.

²¹³Marilee David, "Designing a Program of Vocal Hygiene for Singers," *Journal of Singing - The Official Journal of the National Association of Teachers of Singing* 53/1 (1996): 17.

population. Organizations such as the American Heart Association and The Obesity Society have researched the health benefits of a variety of diets.²¹⁴ Reduction of excess body weight can be achieved through many avenues, but the key factors appear to be dietary adherence and achievement of a net energy loss. This knowledge should eliminate the need for fad diets or other rapid weight loss schemes that can lead to fatigue, irritability, or negative vocal effects.²¹⁵ Weight loss of no more than two to three pounds per week has been recommended repeatedly for obese singers as the most efficient and effective means to achieve a healthy body weight without adverse effects on the voice.²¹⁶ However, it is not the intent of this paper to be prescriptive, and any attempts at weight loss should be undertaken carefully, and ideally, with physician supervision.

Implications

This literature review is the first known attempt to create a collection of the research on body weight, nutrition, and the voice, and as such, has a number of possible implications. The assessment of vocal function at differing body weights and/or states of weight loss is still a new area of research. This collection might assist future researchers who wish to continue the study of body weight or nutrition and vocal function by laying the groundwork of what is currently known. Primarily, this research was intended as an educational resource for singers and voice teachers, by providing access to information regarding body weight and vocal function, beginning to address some of the myths concerning weight and opera singers, and bringing research and evidence-based medicine into a more prominent place in this ongoing discussion.

²¹⁴Jensen et al., S120.

²¹⁵Bunch, 124.

²¹⁶Davies and Jahn, 97.

By highlighting the research that has been done, as well as pointing out areas where the research is still lacking or inconclusive, this document provides a starting point for future research in the field.

Recommendations for Future Research

Because limited research has been done in this area, myriad options exist for further research. One option is to undertake studies similar to those that have been mentioned in this paper, having participants who are trained singers. College or university voice programs having ties with a medical school might provide excellent opportunities and good potential sample sizes, so that vocal function at differing body weights could be studied in trained singers to determine whether the results from previous studies with non-singers can be confirmed.

Another major area for research is in the field of nutrition. Singers and other performers who keep theater hours are known to have nutritional concerns, but almost no research has been conducted to determine how these singers may be aided to make healthy choices for themselves. Many singers have well-established pre-performance routines that they may not want to change, which may explain why research in this area is lacking; however, younger singers or singers who are open to investigating how changes in this routine may help their overall health might be good research participants.

Nutrition and Health Education for singers is a subject area that begs for additional investigation. Health professionals agree that preventing obesity is significantly easier than correcting obesity; thus, the earlier that singers can begin to address their physical health and create good habits, the less likely they are to have future problems.

The education of voice teachers regarding singers and body weight is crucial. Too many teachers hold mythical views on exercise and nutrition, or believe that certain voice types should be overweight. Instructing singers early in their training that obesity can be a hazard of performance life assists in their understanding that obesity does not have to be a requirement. Finding ways to introduce this research to voice teachers and encouraging them to keep their students' physical health in mind, as well as their vocal health, is a necessary part of obesity prevention in the singing community.

Case studies or interviews with singers who have had bariatric surgery would be another helpful avenue for additional research. Bariatric surgery is increasing in popularity, and while the population size is likely too small to conduct research on singers undergoing the surgery, case studies, interviews, or experiential reports from singers who have made that decision, and how it has affected their singing and their careers, would be a useful resource for singers who are considering the surgery.

Concluding Comments

No one body weight or type is the most appropriate or "best" for operatic singing. Throughout the history of the art form, singers of all physiques have had successful careers. However, the evidence demonstrates that singing is most efficient when the singer is at a healthy body weight. A singer's instrument is their body, and all body functions are more efficient at a healthy weight.

There is still much to learn about body weight and the voice. Yet, as more is understood about the interconnectedness of the voice and all other body systems, it becomes more evident that obesity is a hindrance. Physical endurance and stamina are crucial parts of a performance career, and while many obese singers have and do

maintain successful careers while being obese, it is the artistry and technique of these singers that one should choose to emulate, rather than their size. Strength and endurance are necessary requirements, and good physical conditioning provides these requirements more efficiently than excess weight.

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