

PARTICIPANT’S EXPERIENCE WITH BIOFEEDBACK: A PHENOMENOLOGICAL
STUDY

by

Regent Perez

A Senior Honors Project Presented to the

Honors College

East Carolina University

In Partial Fulfillment of the

Requirements for

Graduation with Honors

by

Regent Perez

Greenville, NC

May, 2019

Approved by:

Linda Bolin, PhD, RN, ANP, FAHA

College of Nursing

Abstract

Hypertension is a common factor in the leading cause of death in the United States known as cardiovascular disease (CVD). Although there are a plethora of studies that approach the prevention and containment of CVD by physical activity, pharmacological therapy, diet, lifestyle modification, and repair by surgery, there is a limited amount of research that has focused on the pursuit of biofeedback as a therapy for CVD and the cumulative impact it may have on CVD (O’Callaghan, Rong, & Goh, 2014; Reamy, Williams, & Kuckel, 2018). Although research suggests benefits of biofeedback in many areas including improvement of pain, asthma, anxiety, depression, chronic obstructive pulmonary disease, food cravings, and hypertension (HTN), there are not many conclusive studies as evidenced in a 2013 meta-analysis (Lehrer, et al., 2013). “Biofeedback is a process that enables an individual to learn how to change physiological activity for the purposes of improving health and performance” (“About Biofeedback”, n.d.). The goal of biofeedback as an intervention for patients with HTN is to identify how specific bodily

functions can be controlled in order to regulate or better control HTN.

This research was used to identify participants' perceptions towards biofeedback on their physical health prior to, during, and after biofeedback participation. Understanding the ability of biofeedback to treat HTN is very important. It is also crucial to know what participant's thoughts and feelings are towards biofeedback therapy in order to understand the psychological and emotional elements that participants experience during their participation. In this phenomenological qualitative study, nine participants of paced breathing biofeedback exercises were interviewed to discuss how their thoughts and feelings towards biofeedback were impacted throughout the course of their participation. Participants were between the age of 18 and 35 with a family history of CVD.

Background and Significance

“Biofeedback is a process that enables an individual to learn how to change physiological activity for the purposes of improving health and performance. Precise instruments measure physiological activity such as brainwaves, heart function, breathing, muscle activity, and skin temperature. These instruments rapidly and accurately "feed back" information to the user. The presentation of this information — often in conjunction with changes in thinking, emotions, and behavior — supports desired physiological changes. Over time, these changes can endure without continued use of an instrument" (“About Biofeedback”, n.d.). Research suggests the benefits of biofeedback in many areas including improvement for pain, asthma, anxiety, depression, COPD, food cravings, and hypertension, there are not many conclusive studies (Lehrer, et al., 2013). Biofeedback includes several different health therapies including paced breathing, thermoregulation, and progressive muscle relaxation (Linden, & McGrady, 2016).

Cardiovascular disease (CVD) is the leading cause of death in the United States as well as across the globe (Reamy, Williams, & Kuckel, 2018). Although there are a plethora of studies that approach the prevention and containment of CVD by physical activity, pharmacological therapy, diet, lifestyle modification, and repair by surgery, there is a limited amount of research that has focused on the pursuit of biofeedback as a therapy for CVD and the cumulative impact it may have on CVD (O'Callaghan, Rong, & Goh, 2014; Reamy, Williams, & Kuckel, 2018). High blood pressure, otherwise known as hypertension (HTN) is known to cause increased risk of heart attack, heart failure, stroke, abdominal aortic aneurysm, peripheral artery disease, eye, and kidney problems (Khoury, & Ratchford, 2018). Because of this, HTN is commonly known as the root of the problem that CVD is. Therefore, in order to prevent CVD for people worldwide, a great amount of effort and study should and is being committed to the prevention and/or slowing of increased HTN. The goal of biofeedback in regards to HTN is to identify how specific bodily functions can be controlled in order to regulate or better control HTN.

Although there have been many studies focused on the quantitative data towards biofeedback and its impact on CVD and other health issues, there is a noticeable lack of qualitative research in this field (McCall, et al., 2015; Benicewicz, 2015). This study was conducted in order to present qualitative data to the field of biofeedback and understand the lived experience of individuals who are participating in paced breathing biofeedback studies.

Literature Review and Synthesis

A literature review was performed as an initial step of this senior honors project to become familiar with current literature on biofeedback and participant perception of it as well as to whether gaps exist in this area of research. PubMed, PsycINFO, Google Scholar, and East Carolina University Libraries databases were searched from 2013 to present, using the following terms: “biofeedback”, “hypertension”, “blood pressure”, “heart rate variability”, “device-guided breathing”, “paced breathing”, “slow paced breathing”, “short (and “long”) term effects”, “qualitative”, “phenomenological”; important articles relevant to the topic were also included. Articles ranged from random controlled trials, meta-analyses, prospective unblinded case-series study, case studies, systematic reviews, and two dissertations.

No qualitative studies focused on paced breathing were found in this Literature Review

The qualitative studies focused on paced breathing were found in this literature review. There was one qualitative study focused on the impact of yoga, which contains aspects of paced breathing, on patients with cancer (McCall, et al., 2015). There was also a qualitative study focused on how the specific aspect of yoga that focuses on paced breathing impacted individuals diagnosed with depression (Benicewicz, 2015).

This literature review is organized into three categories. These categories are: the background of paced breathing and the short and long-term effects of paced breathing. These categories provide the background for this senior honors project.

Background

There are several different biofeedback methods that have started to be moderately researched in the past five years. It is clear that you must understand the details and background of the therapies in order to move forward with effectively applying biofeedback research to the field (Linden, & McGrady, 2016). Therefore, this literature review will focus on one therapy specifically while initially giving an overview of the efficacy and reliability of biofeedback as a whole to positively impact health problems and more specifically, CVD and HTN.

The biofeedback therapy that will be focused on is known as paced breathing, slow paced breathing, device guided breathing, or heart rate variability biofeedback (HRVB). In this paper, it will be referred to as paced breathing. Paced breathing is performed by participants that are guided through breathing routines where they are instructed to breathe at a certain rate for a specific amount of time. Blood pressure, heart rate, and a number of other diagnostics may be assessed during and after to assess any significant changes.

In 2013, a number of studies had given some support for the use of paced breathing to help treat a wide array of medical and emotional disorders but additional research was needed to further understand the mechanisms of action (Gevirtz, 2013). In Cernes and Zimlichman's 2017 systematic review on the antihypertensive effect of slow and deep respiration, they believed that most (three of sixty-five were deemed inconclusive) of the studies performed in the field indicated that paced breathing results in enhancement of baroreflex sensitivity which reduced sympathetic tone and lowers blood pressure. One prospective clinical trial confirmed that paced breathing was associated with decreased depressive symptoms, reduced anxiety and mental fatigue, as well as better health related quality of life (Matura, Fargo, Fritz, et al., 2017). Now that the mechanism of action and positive health impacts of paced breathing are understood, it's short-term impacts will be discussed.

Short-term Impacts

Of all the "short-term impact of biofeedback" studies, not all were conclusive and there were differing conclusions based on differing methodologies, samples, and types of studies. A 2014 meta-analysis (n=365) concluded that there was no clear evidence that supported short term impact on participant's blood pressure scores. (van Hateren, Landman, Logtenberg, et al., 2014). Another study showed that treatment with device guided breathing did not lower blood pressure significantly compared to sham procedure or music therapy (Landman, van Hateren, van Dijk, 2017). A different case control trial concluded that paced breathing reduced muscle sympathetic nerve activity but not blood pressure (McClain, Brooks, & Jarvis, 2017).

There have also been conclusive short-term studies that show paced breathing does improve blood pressure. A 2017 study showed that four different deep breathing patterns each decreased participant's blood pressure scores during the paced breathing exercise while quickly returning to normal once the exercise was completed (Herakova, Nwobodo, Wang, et al., 2017). A random control trial found that improvements in blood pressure were observed in pharmacologically controlled hypertensive patients that participated in paced breathing exercises which confirmed that paced breathing can be a crucial and effective adjunct treatment to the best drug treatments for HTN (Jones, Sangthong, Pachirat, et al., 2015).

Long-term Impacts

The literature focused on the long-term effects of paced breathing will now be discussed. In a random controlled trial featuring 75 intervention and 59 control participants with coronary artery disease, it was concluded that one year of paced breathing exercises improved cardiovascular prognosis, increased cardiac autonomic homeostasis and baroreflex sensitivity, and decreased depression and hostility (Yu, Lin, Fan, et al., 2018). In a case study performed in 2017, blood pressure was lowered during paced breathing exercises and evidence was provided to support the regular practice of paced breathing in order to lower blood pressure scores (Zhang, Wang, Wu, et al., 2017). In a dissertation from 2018, 284 studies were analyzed and most of them reported some benefit from paced breathing and recommended a rate of <6 breaths per minute (Murtezani, S., 2018). “Preliminary evidence supports the use of slow paced breathing to affect heart rate variability by increasing it to high frequency variability. Suggestions for optimizing a paced breathing protocol include strict monitoring of breathing tracings during each treatment session so that modifications to the protocol can be made in real time” (Murtezani, S., 2018). This was followed up by another 2018 study that focused in on making sure that paced breathing impacts heart rate variability by making it high frequency variability. “Slow breathing showed the potential to be a simple and inexpensive method to improve autonomic balance and increase the baroreflex sensitivity in hypertensive patients” (Li, Chang, Zhang, et al., 2018).

This literature review confirms that there has been and continues to be literature that states that paced breathing is not beneficial for participants with HTN. The latest literature supports the positive impact that paced breathing has on HTN as well as other health problems. There is a gap in the literature as to whether or not paced breathing decreases risk for HTN. The purpose of this study was to understand the experiences of participants enrolled in a BF quantitative study (young adults with family history of CVD) with paced breathing as the intervention.

Methods

This is a phenomenological study that was conducted in the spring of 2019.

Phenomenological studies are qualitative studies that utilize interviews to focus on the “lived experience” of participants to gain insight on their perception on specific situations (Giorgi, A., Giorgi, B., & Morley, 2017). This type of research has been found to be beneficial in healthcare specific research (Rodriguez, & Smith, 2018). An Institutional Review Board (IRB) application was submitted and approved in February of 2019.

Sample

The sample represents a subset of participants who took part in a “parent” study entitled “Biofeedback for at risk adults with family history of cardiovascular disease”. Nine out of the twenty participants of the initial study were recruited to be interviewed. The inclusion and exclusion criteria are the same criteria of the initial study. The inclusion criteria were as follows: age 18 to 35 years old, cognitively intact to follow instructions, English-speaking, and a family history of cardiovascular disease. The exclusion criteria were having a current diagnosis of hypertension that is controlled with prescribed medication and being unable to place BP finger cuffs on hand due to no digits. Participants ranged in age from 20 to 29 years with a mean of 22.6. There were three male participants and six female participants. There were six white participants, one African-American participant, one Indian-American participant, and one Hispanic participant. In person participants were provided with a consent form to be signed while the interview was conducted while phone participants were sent a pdf copy and printed and returned the form signed.

Data Collection

Interviews were conducted in the Biofeedback lab on the Health Sciences Campus of East Carolina University as well as by phone. There were four in-person interviews and five phone interviews. The interviews ranged from six minutes to 14 minutes with the average time of each interview lasting 10 minutes and 41 seconds. Each interview was audio recorded with the consent of participants. The demographic data that was collected included sex, age in years, and ethnicity. Data was collected through semi-structured interviews using the following overarching

Summary: Data was collected through semi-structured interviews using the following overarching question and subsequent targeting questions:

- Overarching question: Tell me about your thoughts and feelings about biofeedback before you started and if and how they have changed through the course of your participation?
- Tell me about what made you want to participate in this study?
- Tell me what you feel that biofeedback is doing for you as you participate in the exercises?
- Tell me what would make you want to encourage others to participate in biofeedback therapy?

Data Management

Consent forms were collected and maintained by one researcher and are now stored in a secure location. After the interviews were conducted, they were listened to and transcribed into text by one researcher. Transcripts were then coded and subsequently de-identified. Audio files were deleted after full transcriptions were completed. Three researchers read each transcript in order to establish a question-by-question reading of the transcript, identify common words and themes put forth by the participants, and recognize specific quotes that fit with discovered themes.

Data Analysis

The classic analysis strategy was used by three readers of the transcripts (Krueger & Casey, 2015). Data was analyzed for frequency, specificity, emotion, and extensiveness (Krueger & Casey, 2015). Each reader discovered specific themes related to specific quotes observed throughout the collection of transcripts. The readers then had discussion and came to review the recurrent themes and confirm four themes that prevailed through all the readers observation. Below are the findings along with the quotes attached.

Results

Four themes emerged from the data: 1) Skepticism prior to participation 2) Impact of visualizing results 3) Sureness of results after participation and 4) Health benefits encourage participation. The fourth theme had two subthemes: a) cardiovascular benefits and b) mental health benefits. These themes will be described and illustrated by participant's quotes.

Skepticism

The first theme revealed that participants questioned the usefulness and validity of paced biofeedback's ability to produce positive impact. Participants were asked what they thought of biofeedback before participating in the study. These are several of their responses:

"I was...skeptical...there's no way this is actually going to work..."

"Before I was definitely...skeptical about how it really worked..."

"...before I completed the study I don't think I took...centering exercises or breathing exercises or those things very seriously..."

"...before I was kind of skeptical..."

Visual Impact

The second theme revealed was that participants were impacted by being able to see the impact of participating in biofeedback. This happened at two different stages in the study. The first was during participation and the second was after participation. These non-specific comments reflected on the general beneficial aspect of being able to "see" change:

"I like biofeedback because it's real time, watching change happen..."

“...one positive is you can see first-hand results...”

More specific to actively participating in the study, other participants noted the impact that “seeing” the results of biofeedback had on them:

“...it was really just jarring for me to see how impactful just those...basic breathing exercises could be...”

“...just seeing how it tangibly impacted like, blood pressure so quickly was kind of crazy...”

“I like the real time, seeing what's happening with your vital signs, your pulse, respirations, blood pressure...”

“...I could see exactly how it was affecting me...”

Participant’s ability to see the impacts that changing their physiological environment had on their vital signs in real-time was helpful and it was found that this element led into the third theme of participants being sure of biofeedback’s impact after participating.

Sureness

Participants moved from a place of skepticism before participating to sureness after participating because of the visual impact of seeing their body’s response to the paced breathing. This was seen through participant’s expressing thoughts including:

“...coming back and seeing that it actually does work.”

“...I know that this is actually changing something...”

“I’m no longer in a space where I need to convince myself if it’s...legitimate or reputable or significant...”

The new knowledge changed the participants beliefs because they had taken part in the therapy and the results were personally seen throughout the paced breathing exercises.

Health Benefits

The final theme was selected because participants were confident of the usefulness of paced breathing as a beneficial therapy that produced physical change (“About Biofeedback”, n.d.). Because of this, they expressed a desire to use biofeedback in their lives after participating in the study. Participants stated that they noticed not only helpful cardiovascular effects because of visual impact but also experienced mental health benefits noting that paced breathing helped positively impact “stress”, “anxiety”, “sleep”, and “panic”. Cardiovascular benefit related comments were primarily long-term focused while mental health benefits were short-term/immediate impact related. Three participants noted positive impacts in both cardiovascular and mental health:

“I have a strong history of hypertension...on both sides of my family...I have lots of anxiety and panic...so the paced breathing...was really neat to pair...with the biofeedback...helping manage a risk factor for cardiovascular disease.”

“...those two [stress and cardiac benefits] are pretty tied for me...”

Cardiovascular benefits. Participants stated:

“I do have a...heart irregularity that causes my heart to beat too fast and so I think taking time to consciously slow down and breath is really important for me.”

“...biofeedback kind of confirmed my belief that this stuff works and if I do it long term, then maybe I could...protect my heart and live longer.”

“I was able to...control my...breathing...cuz I always have a problem with my heart rate...it actually... helped by participating in this study.”

Mental health benefits. Participants stated:

“...biofeedback is a great way to...maybe not treat or manage mental health, but assist.”

“looking for ways to kind of control...day-to-day stress...so being able to more effectively handle...stress throughout the day was really useful...”

“I do the biofeedback when I get stressed but sometimes if it’s something that’s out of my control, it can be a little bit less effective.

“...it definitely helps me sleep and...calm down on stressful days which is good...”

“...stress contributes to just about every negative health outcome...and I think biofeedback was really helpful for me in having a strategy that I knew that was effective to like, tone down the stress.”

“It definitely worked for me and I know I was able to deal with stress better...”

Discussion

This research provided helpful insight into understanding the lived experience of participants of a biofeedback study specifically related to paced breathing exercises impact on blood pressure in young adults with a family history of CVD. Because of the lack of qualitative research done in this area, this information is crucial to developing future research and participation models for individuals that biofeedback could positively impact. The themes discovered led to several discussion points that were not themes, but are important to communicate when discussing the data collected in this study.

Questioning to Belief

Participants moved from a lack of understanding and skepticism to understanding and trust in the beneficial impact of biofeedback in their lives. The main way they communicated that this happened was through seeing visually how their vital signs changed in front of them and being able to understand how they were controlling their body. They also stated that being able to see graphic printouts and visual pictures of their autonomic nervous system after participating was impactful. This provided the participant with tangible individualized data which also increased their confidence in the usefulness and impact of biofeedback. Because of this, lack of knowledge and understanding of biofeedback seems to be one of the main inhibitors for participants with a history of hypertension. Therefore, it is hypothesized that in order for individuals to take part in biofeedback as a beneficial health therapy, they will need to have a better understanding of biofeedback and confidence in its effects.

Promoting Apps/Devices

There are several apps and paced breathing devices that are currently in use to assist people in biofeedback including a pediatric app that helps children reduce their heart rate and anxiety (Morrow, et al., 2018). A device called RESPeRATE is approved by the FDA to lead patients in paced breathing exercises (Mahtani, et al., 2016). Despite biofeedback becoming marketed in apps and approved medical devices, there is still a large lack of knowledge of these items as evidenced by the interviews in this study. None of the participants knew about these programs and their lack of knowledge before participation meant that they would not partake in the therapy.

It is hypothesized that the use and impact of biofeedback would greatly increase if health care providers educated their patients about biofeedback apps/devices and advocated for their beneficial impact. A helpful step to take in regards to this is to provide hospitals, providers, county public health offices, and health profession training programs with resources to use and research more intently on the positive impacts of paced breathing apps/devices. An increase in

research more intently on the positive impacts of paced breathing apps/devices. An increase in knowledge and advocacy by the medical community of biofeedback and the opportunities to use it would likely increase the use of biofeedback for the patients that are cared for.

Sureness Does Not Translate to Implementation

While all of the participants communicated a new or strengthened trust in biofeedback as a helpful therapy, only half of them communicated continued use of biofeedback after finishing the study. This is important to note because it communicates that while knowledge and understanding are important and helpful, they were not enough to influence all participants. Participants that communicated their continued use stated specific issues of “stress”, “panic”, “fast heart rate”, “high blood pressure”, and “sleep” as main reasons for continuing use. The participants that did not communicate continued use did not have a perceived need that related to the use of biofeedback, which could be attributed to their lack of use of paced breathing. Potential future research is needed to explore concepts of patient motivation and self-care. Included variations of this study could be to exclude education regarding the mechanisms of action, include education on cardiovascular disease, or not allow patients to see their vital signs.

Implications for Practice

Primary prevention is the first step of health care and long-term benefits should always be considered and encouraged when managing health and creating long-term care plans. Paced breathing interventions and other modes of biofeedback could prove to be beneficial to patients with family history of cardiovascular disease and mental health issues. Encouraging understanding and participation in treatment modalities yields a positive impact to those who participate, minimizing risk factors and maintaining healthy standards of living.

It is important to recognize that biofeedback is also an asset in the secondary and tertiary care settings of both mental and cardiovascular health. Reducing costs and improving care are two main reasons as cardiovascular disease costs the United States \$199 billion per year while mental health and chronic conditions cost 90% of annual health care costs (Benjamin, et al., 2018; Buttorff, Ruder, & Bauman, 2017). Introducing impactful nonpharmacological therapies to patients all over the health spectrum would allow for a decrease in spending and increase in ownership of health responsibility.

Before patient's can participate, an assessment of their willingness to participate in nonpharmacological interventions should be included in their assessment. This could include education and access to apps and devices previously mentioned. Revealing the amount of time, energy, and money patients are willing to invest in this therapy along with how much pain and frustration their current health status is causing them would be good starting points for assessing patient willingness and desire to utilize paced breathing.

Recognizing that there are different uses for biofeedback is another big implication for future research and implementation in paced breathing therapies. The creation of two separate focus groups of cardiovascular benefits and mental health benefits would be impactful and lead to future understanding of specific needs and desires to be fulfilled by the different categories of participants. In growing to understand and differentiate between the needs and desires of each group, this could lead to specialized care for each patient population.

Conclusion

Biofeedback is a progressive therapy that can be used to impact patient health (BP and CVD risk) and perception of health (stress and anxiety). Participants of paced breathing studies moved from a place of skepticism before participating to sureness in the therapies benefits and usefulness after participating. This was due to increased knowledge garnered by visual aides and explanation. This influenced some of them to continue to use biofeedback for recognized health benefits towards cardiovascular and mental health. Future qualitative studies may bring deeper understanding to the lived experience of a biofeedback participant and what influences their understanding, perception, and uses of biofeedback in the future.

References

- About Biofeedback. (n.d.). Retrieved March 20, 2019, from <https://www.aapb.org/i4a/pages/index.cfm?pageid=3463>
- Benicewicz, A. J. (2015). Mechanisms of change of pranayama: A qualitative study exploring how voluntarily controlled breathing reduces depression.
- Benjamin, E. J., Virani, S. S., Callaway, C. W., Chamberlain, A. M., Chang, A. R., Cheng, S., . . . American Heart Association Council on Epidemiology and Prevention Statistics Committee and Stroke Statistics Subcommittee. (2018). *Heart disease and stroke Statistics—2018 update: A report from the american heart association*. *Circulation*, 137(12), e67-e492. doi:10.1161/CIR.0000000000000558
- Buttorff C, Ruder T, Bauman M. (2017) *Multiple Chronic Conditions in the United States*. Santa Monica, CA: Rand Corp.; 2017.
- Cernes, R. & Zimlichman, R. (2017). Role of paced breathing for treatment of hypertension. *Current Hypertension Reports*, 19(45), pp. 1-9. doi: 10.1007/s11906-017-0742-1
- Gevirtz, R. (2013). The promise of heart rate variability biofeedback: evidence-based applications. *Biofeedback* 41, 110–120. doi: 10.5298/1081-5937-41.3.01
- Giorgi, A., Giorgi, B., & Morley, J. (2017). The descriptive phenomenological psychological method. In Willig, C., & Rogers, W. S., *The SAGE handbook of qualitative research In psychology: Second edition*, pp. 176-192. Retrieved from <https://www.researchgate.net>
- Herakova, N., Nwobodo, N. H. N., Wang, Y., Chen, F., & Zheng, D. (2017). Effect of respiratory pattern on automated clinical blood pressure measurement: An observational study with normotensive subjects. *Clinical Hypertension*, 23(1), 1-7. doi:10.1186/s40885-017-0071-3
- Jones, C. U., Sangthong, B., Pachirat, O., & Jones, D. A. (2015). Slow breathing training reduces resting blood pressure and the pressure response to exercise. *Physiological*

resting blood pressure and the pressure responses to exercise. *Physiological Research*, 64(5), 673-682.

- Khoury, S. R., & Ratchford, E. V. (2018). Hypertension. *Vascular Medicine*, 23(3), 293-297. doi:10.1177/1358863X18764836
- Krueger, R. A., & Casey, M. A. (2015). *Focus groups: A practical guide for applied research*. (5th ed.). Thousand Oaks, CA: Sage Publications, Inc.
- Landman, G. W. D., van Hateren, Kornelis J. J., van Dijk, P. R., Logtenberg, S. J. J., Houweling, S. T., Groenier, K. H., . . . Kleefstra, N. (2014). Efficacy of device-guided breathing for hypertension in blinded, randomized, active-controlled trials: A meta-analysis of individual patient data. *JAMA Internal Medicine*, 174(11), 1815-1821. doi:10.1001/jamainternmed.2014.4336
- Lehrer, P., Vaschillo, B., Zucker, T., Graves, J., Katsamanis, M., Aviles, M. & Wamboldt, F. (2013). Protocol for heart rate variability biofeedback training. *Biofeedback*, 41(3), pp. 98-109. doi:10.5298/1081-5937-41.3.08
- Li, C., Chang, Q., Zhang, J., & Chai, W. (2018). Effects of slow breathing rate on heart rate variability and arterial baroreflex sensitivity in essential hypertension. *Medicine*, 97(18). doi:10.1097/md.00000000000010639
- Linden, W. & McGrady, A. V. (2016). Essential hypertension. In M. Schwartz & F. Andrasik (Eds.), *Biofeedback: A practitioner's guide* (4th edition, pp. 383-399). New York, NY: The Guilford Press.
- Mahtani, K. R., Beinortas, T., Bauza, K., & Nunan, D. (2016). Device-guided breathing for hypertension: A summary evidence review. *Current Hypertension Reports*, 18(4), 33.
- Matura, L. A., PhD, Fargo, J., PhD, Fritz, J. S., MD, Smith, K. A., MD, Vaidya, A., MD, Pinder, D., BS, . . . Kawut, Steven M., MD, MS. (2017). Slow-paced respiration therapy to treat symptoms in pulmonary arterial hypertension. *Heart & Lung: The Journal of Acute and Critical Care*, 46(1), 7-13. doi:10.1016/j.hrtlng.2016.11.001
- McClain, S., Brooks, A., & Jarvis, S. (2017). An acute bout of a controlled breathing frequency lowers sympathetic neural outflow but not blood pressure in healthy normotensive subjects. *International Journal of Exercise Science*, 10(2), 188-196.
- McCall, M., Thorne, S., Ward, A., & Heneghan, C. (2015). Yoga in adult cancer: an exploratory, qualitative analysis of the patient experience. *BMC Complementary and Alternative Medicine*, 15(1).
- Morrow, A. M., Burton, K. L. O., Watanabe, M. M., Cloyd, B. H., & Khut, G. P. (2018). Developing BrightHearts: A pediatric Biofeedback-Mediated relaxation app to manage procedural pain and anxiety. *Pain Practice*, 18(6), 698-708. doi:10.1111/papr.12655
- Murtezani, S. (2018). *Heart rate variability and paced breathing: Review: A pilot study*
- O'Callaghan, C. J., Rong, P., & Goh, M. Y. (2014). National guidelines for the management of absolute cardiovascular disease risk. *Medical Journal of Australia*, 200(8), 454-456. doi:10.5694/mja13.11162
- Reamy, B. V., Williams, P. M., & Kuckel, D. P. (2018). *Prevention of cardiovascular disease*. Primary Care: Clinics in Office Practice, 45(1), 25-44. doi:10.1016/j.pop.2017.11.003
- Rodriguez, A., & Smith, J. (2018). Phenomenology as a healthcare research method. *Evidence Based Nursing*, 21(4), 96-98. doi:10.1136/eb-2018-102990
- van Hateren, K., Landman, G., Logtenberg, S., Bilo, H., Kleefstra, N. (2014). Device-guided breathing exercises for the treatment of hypertension: An overview. *World Journal of Cardiology*, 6(5), 277-282. doi:10.4236/wjcv.2014.65277

Yu, L., Lin, I., Fan, S., Chien, C., & Lin, T. (2018). One-year cardiovascular prognosis of the randomized, controlled, short-term heart rate variability biofeedback among patients with coronary artery disease. *International Journal of Behavioral Medicine*, 25(3), 271-282. doi:10.1007/s12529-017-9707-7

Zhang, Z., Wang, B., Wu, H., Chai, X., Wang, W., & Peng, C. (2017). Effects of slow and regular breathing exercise on cardiopulmonary coupling and blood pressure. *Medical & Biological Engineering & Computing*, 55(2), 327-341. doi:10.1007/s11517-016-1517-6