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Biofeedback and Anxiety Reduction: An Occupational Therapy Intervention for Persons with Long Covid

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Biofeedback and Anxiety Reduction:
An Occupational Therapy Intervention for Persons with Long Covid

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Executive Summary

Background: People who acquire Covid 19 may have symptoms lasting over three months, called Long Covid. It is estimated that one in five people in the United States has Long Covid. Unpleasant symptoms of Long Covid are many including anxiety. People with Long Covid have a difficult time engaging in everyday activities and have a poor quality of life. Occupational therapy practitioners using heart rate variability (HRV) biofeedback may help decrease anxiety in the Long Covid population. There is limited research on occupational therapy and HRV biofeedback.

Purpose: The problem the study addressed was to investigate the use of HRV biofeedback therapy delivered by an occupational therapy practitioner and its effectiveness to decrease anxiety levels in people with Long Covid. The research aimed to discover if HRV biofeedback decreased anxiety and increased the quality of life in persons with Long Covid.

Theoretical Framework: There are two guiding theoretical frameworks for this pilot study, the Model of Human Occupation, and the Behaviorist Theory.

Methods: This study was quasi-experimental in the form of a pre-test-post-test design. Each participant was administered two pre-tests/posttests, the Generalized Anxiety Disorder (GAD) and the Quality of Life Scale (QOLS). Each participant received eight biofeedback sessions.

Results: The results of this study found that HRV biofeedback demonstrated potential in decreasing anxiety and improving quality of life in persons with Long Covid. This study yielded a low sample size; therefore, more data needs to be collected in order to determine if the results are statistically significant. A minimal clinical difference of a 4-point change is considered clinically meaningful. Ten out of eleven participants in this study reported a decrease in anxiety based on the post-test outcome measures of the GAD-7 which is considered clinically meaningful. An increase of 8-9 points in the QOLS is considered a 60% improvement in quality of life. Nine out of eleven participants reported an improvement in their quality of life and as a group mean score, which was found to be clinically meaningful.

Conclusions: The results of this pilot study appear promising for the use of HRV biofeedback to reduce anxiety and improve QOLS in persons with Long Covid. The study will continue to collect data until there are sufficient participants to perform paired-sample t-tests to determine the statistical significance of pre-test/post-test scores for both the GAD-7 and the QOLS.

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I would like to dedicate this not only to my children but also to my grandchildren and future great-grandchildren: I hope that you know that you can achieve your dreams at any age and with God by your side.

EASTERN KENTUCKY UNIVERSITY
COLLEGE OF HEALTH SCIENCES
DEPARTMENT OF OCCUPATIONAL SCIENCE AND OCCUPATIONAL THERAPY

CERTIFICATION OF AUTHORSHIP

Submitted to (Faculty Mentor's Name): Dr. Cindy Hayden
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Student's Signature: Colette Freda

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Section I: Nature of the Problem and Problem Identification

Introduction

The Covid 19 virus is described as a severe acute respiratory infection initially discovered in Wuhan, China (Ogundunmade, 2022). As of February 10, 2023, there have been 755,385,709 confirmed cases of COVID-19 globally and 101,211,478 cases in the United States. (World Health Organization [WHO], 2023). People who acquire Covid 19 may have symptoms lasting over three months, called post-Covid-19 syndrome or Long Covid. It is estimated that one in five people in the United States has Long Covid (Centers for Disease Control and Prevention [CDC], 2022) which would be roughly 20,242,295 people. Long Covid symptoms include dyspnea, cognitive impairments, sore throat, chest pain, palpitations, diarrhea, nausea, myalgia, joint pain, hair loss, skin rashes, fatigue, and anxiety (Yong & Liu, 2021). A systematic review of post-viral fatigue interventions found people with Long Covid experience a long-term condition of chronic fatigue, linked to post-exertional exhaustion. This fatigue can be compounded by shortness of breath and anxiety (Fowler-Davis et al. (2021).

The Covid 19 pandemic has had broad-reaching impacts, both physically and mentally. It has impacted individuals' mental health such as stress and anxiety levels, uncertainty about vaccine efficacy, and possible further deaths caused by Covid-19 (Hatta, 2020). Generalized anxiety, depression, and other symptoms of mental illness, including irritability, withdrawal, and trouble concentrating, are conditions that can negatively impact a person's ability to engage in meaningful occupations (Dobrez et al.,2010; Demirci & Calapkorur, 2022). Generalized anxiety is a condition that is different from worry in that it is persistent and can limit people from engaging in things that they enjoy. Symptoms of generalized anxiety include feeling restless,

irritable, having difficulty concentrating, difficulty sleeping, and muscle aches or unexplained pain (National Institute of Mental Health, 2023).

The Covid pandemic has resulted in a global need for neurorehabilitation programs to treat the Long Covid population (Masood et al., 2023). In a study completed by Braga and colleagues (2022) on the effects of Covid 19, it was found that post- Covid participants experience neuropsychological problems including anxiety, brain fog, depression, and a decline in quality of life. Every participant in this study reported memory problems post-Covid, and the majority had higher scores for anxiety based on the Hospital Anxiety and Depression Scale. Furthermore, the survivors, whether hospitalized or not, had cognitive and emotional deficits that lasted up to eight months after the initial infection (Braga et al., 2022).

Inpatient rehabilitation settings have high rates of these conditions, with nearly one-third of patients experiencing the above symptoms (Pisegna et al., 2022). In the inpatient rehabilitation facility setting, skilled rehabilitative therapy is provided by an interdisciplinary team including occupational, physical, speech therapy, nursing, and physiatrsts. The main goal of this team is to promote physical and mental health contributing to independence with activities of daily living (ADL's). Medicare rules require each patient to engage in three hours of therapy a day, therefore it is essential to maximize productive time spent in therapy and to have the patients engage in meaningful occupations (Pisegna et al., 2022; CMS, 2023). For those with Long Covid, adhering to these standards may be difficult and seem overwhelming. Specifically, occupational therapy interventions are vital to this population as the interventions can provide instruction and strategies to combat the negative physiological and psychological effects of Long Covid.

To address the need for additional treatments for the Covid 19 population, this researcher posits that biofeedback therapy can be beneficial to use during occupational therapy sessions.

Biofeedback is a way for people to self-regulate involuntary processes by activating reticular and thalamic processes to understand how to calm themselves through various methods such as meditation or self-dialog (Hatta, 2020). Specifically, biofeedback can enhance the person's ability to modulate feelings and emotional arousal or emotional regulation (Weerdmeester et. al., 2020). Understanding the psychological and physiological processes of the body is essential when implementing biofeedback (Hatta, 2020). Occupational therapy practitioners have substantial training in all systems of the body, are versed in relaxation techniques, and mental health as outlined in the Occupational Theoretical Framework (AOTA, 2020). Occupational therapy practitioners are fully capable of using biofeedback as a treatment intervention for anxiety.

Although there is evidence in the literature for the effectiveness of biofeedback on many disorders such as anxiety, stress, asthma, chronic pain, and Raynaud's disease, there are no peer-reviewed articles on the use of HRV biofeedback with individuals with Long Covid. Heart rate variability (HRV) biofeedback may be a tool to help decrease anxiety in persons suffering from Long Covid to enable them to successfully participate in meaningful occupations.

Problem Statement

There is a growing need for additional occupational therapy practitioners to treat and work with the Long Covid population that is struggling with anxiety. Occupational therapy practitioners can implement interventions with clients to avert and treat symptoms of anxiety resulting from or coexisting with Long Covid. Occupational therapy practitioners can provide biofeedback and teach individuals to decrease their anxiety using relaxation techniques such as slow breathing. These interventions can be practiced by clients in in-patient and/or community settings and then integrated into their daily routines.

The problem the Capstone project addressed was to investigate the use of heart rate variability biofeedback therapy delivered by an occupational therapist and its effectiveness to decrease anxiety levels in people with Long Covid. The research aimed to answer 1) Does HRV biofeedback decrease anxiety in persons with Long Covid? and 2) Does HRV biofeedback increase the quality of life in persons with Long Covid?

Project Purpose

The purpose of this capstone project is to fulfill a gap in the medical and mental health literature discovering how biofeedback can be used to decrease anxiety in the Long Covid population. Research on the effects of biofeedback for anxiety with persons with Long Covid would contribute to the understanding of non-pharmacological interventions. This research could support best practice guidelines for occupational therapy clinicians in using biofeedback to treat anxiety and improve the quality of life for this population.

Research Objectives

The objective of this research is to determine if an occupational therapy treatment intervention consisting of heart rate variability biofeedback will decrease the anxiety of individuals with Long Covid. This capstone project aims to gain insight into current information on biofeedback on mental health, occupational treatment interventions for Long Covid, and how to promote improved quality of life for these individuals. The expected outcomes of this research will be decreased anxiety for participants leading to increased engagement in meaningful activities of daily living and improved quality of life.

Theoretical Framework

This study is grounded in the Model of Human Occupation (MOHO) theory and the Behaviorist Theory. MOHO concepts are mindful of a person's volition, habituation, performance ability, and environmental conditions which are all important aspects of quality of life. Occupational therapy practitioners assist persons to engage in occupations that shape their routines, abilities, thoughts, and feelings about themselves (Kielhofner, 2019). With the participants having Long Covid and anxiety, it is essential they engage in purposeful activities to promote a better quality of life.

Behaviorist theorists such as B.F. Skinner, postulate that using operant conditioning will bring about physiologic change (Weerdmeester et.al., 2020). In biofeedback training, participants receive feedback on their heart rate and other biomarkers on a screen and are then taught how to self-regulate and bring about positive change to reduce anxiety. By providing real-time feedback, biofeedback can help persons to understand the relationship between their thoughts, emotions, and physiologic responses. The goal of occupational therapy treatment intervention is to have HRV biofeedback assist in lowering the participant's anxiety, therefore enabling them to participate in daily activities that are meaningful to them.

Significance of the Study

This pilot study aims to provide data in support of a treatment intervention that occupational therapy practitioners and other disciplines can use with clients to decrease anxiety in the Long Covid population. The ability to positively impact adults during stressful times in their life is the founding principle of this study. This impact aligns with the AOTA vision 2025, "Occupational therapy excels in working with clients and within systems to produce effective outcomes" (AOTA, 2021). The proposed capstone project will have evaluation measures to

validate sustainability and success. In addition to sustainability, the study may impact positively the individual level (participant), group level (families of the participant), community level (possibly decreased hospitalizations), and national level (lower Medicare expenditure for hospitalizations).

Summary

There is a gap in the literature regarding occupational therapy practitioners treating individuals with anxiety secondary to Long Covid. Many individuals are not coping well with the effects of Long Covid and the additional condition of anxiety. There is a need for research to identify alternative treatments that are non-pharmacological in nature to treat this concomitant anxiety. HRV biofeedback may be a tool to help decrease anxiety in persons with Long Covid. Decreasing anxiety may assist those with Long Covid population lead healthier and occupationally more fulfilling lives.

Section II: Literature Review

Introduction

A review of the peer-reviewed literature on Long Covid, biofeedback, and anxiety was conducted utilizing Google Scholar, Cochrane Library, and PubMed. Articles from the years 2012-2023 were weighted more heavily, however, a few seminal studies were included from as far back as 2003. The search items used were Long Covid, Occupational Therapy Interventions for Individuals with Long Covid-19, Mental Health Challenges, Occupational Therapy Interventions for Individuals with Mental Health Challenges, Occupational Therapy Interventions for Individuals with Anxiety, Use of HRV Biofeedback as a Treatment Intervention for Mental Health Challenges, Use of Biofeedback as a Treatment Intervention for Anxiety, and

Occupational Therapy Intervention Using Biofeedback for Anxiety in Those with Long Covid. Many of the studies provided strong statistical analysis including the Shapiro-Wilk test, nonparametric Wilcoxon Signed Rank test, and paired-sample t-tests. In addition, many of the studies reported no conflict of interest, and most included inclusion and exclusion criteria.

Long Covid

Long Covid is a significant United States public health problem as evidenced by the gravity of the condition and a significant number of deaths from the disease. Long Covid is associated with physical conditions such as diabetes, cardiovascular disease, hypertension, cancer, and chronic lung disease (Demirci & Calapkorur, 2022; Masood et al., 2023; Dehmiyani et al., 2022). Symptoms of Long Covid include anxiety, depression, dyspnea, cognitive impairments, sore throat, chest pain, palpitations, diarrhea, nausea, myalgia, joint pain, hair loss, and skin rashes (Yong & Liu, 2021). In addition, people with Long Covid can present with chronic fatigue which is linked to post-exertional exhaustion. Post-exertional exhaustion can be compounded by shortness of breath and anxiety (Fowler-Davis et al., 2021) Traditional pharmacological approaches to treat active Covid 19 include drugs such as Remdesivir, HCQ & Chloroquine, Favipiravir, Molnupiravir, Arbidol, Kaletra, Oseltamivir, IVIG & Interferon (Aboulfathiyarmohammadyar, 2022). Non-pharmacological approaches to treat symptoms of Covid -19 include meditation, guided relaxation, diaphragmatic breathing, and biofeedback. Mobile apps on mindfulness and cognitive behavioral therapy principles have also helped alleviate mental health symptoms during the pandemic and were promoted through the Veterans Affairs Health Care System (Satre et al., 2021; Sharma & Goswami, 2022).

Persons experiencing Long Covid experience more than physiologic effects. Those who have had Long Covid may suffer from a variety of psychological effects, including anxiety and depression. People who have experienced Covid-19 infection may go through phases of psychological responses such as denial, anger, depression, fear, and acceptance affecting how they cope with daily activities. Individuals need physical activity and exercise to promote mental health, both of which can be compromised with isolation of the Covid virus (Hatta, 2020). Long Covid can worsen from moderate to severe depression with a poorer quality of life (Fowler-Davis et al., 2021). A study by Remya Lathabhavan (2021) investigated the relationship of having a fear of Covid-19 against different psychological outcomes. Based on the findings, there is increased stress among people who are fearful of Covid-19 and have a negative relationship with life satisfaction and well-being. In addition, the investigator found a greater amount of mental health problems in females compared to males. The above findings present an opportunity for occupational therapy practitioners to expand on interventions specifically targeting mental health challenges.

Occupational Therapy Interventions for Individuals with Long Covid 19

This section will cover how occupational therapy practitioners have provided services to patients with long covid. Occupational therapy practitioners have assessed and treated those clients who have had physical conditions associated with Long Covid. Occupational therapy practitioners have also engaged in treating clients with mental health issues and Long Covid, most notably through telehealth services.

Delivery of occupational therapy interventions may be provided in a clinic, at home, or via telehealth. Access to care is a concern with the knowledge that prior to the Covid pandemic,

fewer than one-third of persons with mental health problems ever sought help (Satre et al., 2021). Pulmonary Tele-rehabilitation is a way to meet the needs of persons who may not have access to care and who may live in rural areas. Occupational therapy interventions focusing on breathing techniques such as pursed lip breathing and straw breathing are a way to improve ventilation in persons who have residual symptoms of Covid 19. Persons receiving breathing and therapeutic exercises were shown to recover faster and demonstrated independence with their activities of daily living (Sharma & Goswami, 2022). Understanding the importance of proper breathing coupled with a home exercise program can improve functional outcomes. Telehealth addressing health disparities and accessibility may be an additional way for occupational therapy practitioners to help persons with Long Covid.

As part of telehealth for mental health, there have been more mobile application-based interventions in recent years. In an article by Satre et al. (2021), researchers discuss the integration of mobile app-based interventions into mental health in response to the Covid 19 pandemic along with an increased treatment need for those persons with anxiety, depression, and substance use disorders. Mobile apps on mindfulness and cognitive behavioral therapy principles have helped alleviate mental health symptoms during the pandemic and were promoted through the Veterans Affairs Health Care System (Satre et al., 2021; Sharma & Goswami, 2022). The use of mobile apps to carry over learned strategies of the capstone project, i.e., breathing techniques to foster self-monitoring, can be an adjunct to patient care and promote equal access to care.

Mental Health Challenges

Within mental health disorders, there have been psychological sequelae from Covid-19 on a person's mental health. These range from depression, anxiety, post-traumatic stress disorder, memory loss, attention problems, and fatigue resulting from autonomic nervous system

dysfunction (Ogundunmade, 2022; Yong & Liu, 2021). The most common neuropsychological problem for persons with Long Covid was “brain fog” with reduced cognitive function, which resulted in a decreased quality of life (Graham et al., 2021). The authors also report half of the participants had an abnormal neurologic test with impairments in short-term memory and attention functions. Given these statistics, it is an opportunity for occupational therapy practitioners to assess how they may serve the older population and develop interventions to reduce anxiety and depression while enabling them to achieve well-being within their chosen occupations. Unfortunately, there are many adults who face mental health difficulties including depression and anxiety (Mulholland & Jackson, 2018). There has been an increase in stress, anxiety, and depression (Satre et al. 2021). Anxiety increased by 18% based on the Household Pulse Survey from June 2019 to May 2021, part of which time the United States was experiencing high rates of Covid.

Researchers Gunnarsson et al., 2023, report mental health disorders such as anxiety and depression can lead to low performance of everyday occupations and furthermore, a decrease in satisfaction of performance. The most experienced challenges were related to the main area of self-care as well as household management and socialization. Moreover, the research revealed people with anxiety/depression have difficulty getting up in the morning, completing daily tasks, and have sleep disturbances. Anxiety and depression have been found to impact one’s productivity at work secondary to compounding factors such as lack of energy and fatigue (Gunnarsson et al., 2023; Mulholland & Jackson, 2018).

Occupational Therapy Interventions for Individuals with Mental Health Challenges

Occupational therapy practitioners are versed in relaxation techniques and mental health as outlined in the Occupational Theoretical Framework (AOTA, 2020). The American

Occupational Therapy Association Vision 2025 states “as an inclusive profession, occupational therapy maximizes health, well-being, and quality of life for all people, populations, and communities through effective solutions that facilitate participation in everyday living.” (AOTA, 2021). Occupational therapy practitioners have an obligation to follow these tenants through our delivery of services for all populations including those with mental health disorders (AOTA, 2021).

Occupational therapy practitioners may incorporate aspects of psychotherapy when working in the mental health setting. Patients often present with fear of treatment due to triggers from the illness and pain, which can be another aspect of overcoming patient objections (Brown et al., 2020). Occupational therapy practitioners are educated in the therapeutic use of self and reflective listening. Reflective listening creates a connection with the patient, fosters collaboration of goals that are meaningful to the patient and is shown to create a higher patient-practitioner satisfaction rate (Brown et al., 2020). Strategies in psychotherapy can include cognitive behavioral therapy (CBT) which focuses on talk therapy, and activity-based approaches focusing on writing or art, to obtain mental wellness (Marshall et al., 2022). Although talk therapy can be present in occupational therapy practice, it is important to connect talk therapy with occupational performance to highlight occupational therapy skills (Marshall et al., 2022).

In addition to maximizing health and well-being, AOTA’s pillar on being effective, states “occupational therapy is evidence-based, client-centered, and cost-effective” (AOTA, 2021). Occupational engagement can improve a client’s health and there is strong evidence linking physical activity to positive health outcomes (Stav et al.,2012). Leisure activities were found to have positive health outcomes such as higher cognitive levels and decreased risk of dementia,

and generalities such as increased survival rates. Activities include reading, going to museums, crossword puzzles, gardening, and playing board games (Stav et al., 2012). Pisegna et al., (2022) discuss the need for additional occupational therapy interventions to address anxiety and depression with patients in the inpatient rehabilitation setting.

Occupational Therapy Interventions for Individuals with Anxiety

This section will discuss how anxiety affects the human body and how occupational therapy can help clients decrease their anxiety in everyday life. Anxiety can impact the sympathetic nervous system (SNS) or ‘‘fight-or-flight response and the parasympathetic nervous system (PNS) impacts the ‘‘rest and digest’’ response (Champagne et al., 2015). The parasympathetic nervous system has been correlated with healthy cognitive aging; however, extreme sympathetic nervous system activity has been correlated with worsened cognitive decline (Knight et al., 2020). Occupational therapy practitioners are faced with patients who may not be motivated to perform therapeutic activities due to fear of the activity or of failure (Brown et al., 2020). When a patient is fearful, their vagal tone may increase the PNS response (Knight et al., 2020). The polyvagal theory is described as the ability for brain structures to modulate PNS activity to avoid dangers and thereby facilitate social interaction (Knight et al., 2020). The polyvagal theory supports the need to help individuals feel safe and secure, to promote engagement in meaningful life roles and activities (Champagne et al., 2015). The neurophysiological findings in the articles by Knight et al. (2020) and Champagne et al. (2015) strengthen and help to support the need to provide additional occupational therapy patient-focused interventions to people with mental health challenges.

Occupational therapy practitioners can address anxiety symptoms by allowing the patient to identify goal-directed activities that give fulfillment and meaning to the patient, thus facilitating the mitigation of their anxiety symptoms (Pisegna et al.,2022). Because mental illness, such as anxiety, can hinder progress made toward a person's independence, it is essential for occupational therapy practitioners to understand mitigation strategies. One's identity is shaped by their doing, being, and belonging, and with some people, anxiety can disrupt this identity and create a sense of loss (Mulholland & Jackson, 2018).

Cognitive and behavioral strategies are tools for interventions that have been found successful in reducing anxiety and depression with secondary positive outcomes within life satisfaction, independence with activities of daily living, and return to work situations (Pisegna et al.,2022; Mulholland & Jackson, 2018). One example of a behavioral strategy is the use of weighted blankets with adults who were admitted to an acute inpatient psychiatric hospital setting. Weighted blankets are considered a type of sensory processing-related intervention that utilizes deep-pressure touch stimulation (Champagne et al., 2015). Occupational therapy practitioners use modalities and activities that provide deep pressure to illicit goals of achieving specific functional outcomes. Another example, frequently in pediatric practice, is use of deep pressure stimulation which is provided by squeezing the child or using brushing techniques. In addition to sensory processing, the researchers report weighted blankets can influence the autonomic nervous system, in particular by lessening the sympathetic nervous system (Champagne et al., 2015).

Use of HRV Biofeedback as a Treatment Intervention for Mental Health Challenges

One particular method for treating patients to decrease their anxiety is by using biofeedback, specifically heart rate variability (HRV) biofeedback. HRV can be described as the minute changes between heart beats which are linked to cardiac health. The benefits of heart rate variability training show increased vagal activity, controlled heart rate, and can reduce anxiety and depression. HRV biofeedback has been shown to decrease psychiatric symptoms and improve cognitive functioning in older adults (Jester et al.,2019). Jester et al.(2019) used biofeedback with diagnoses including anxiety, depression, and cardiac conditions. Positive results were found in improved anxiety, depression, and attentional skills. Using heart rate variability biofeedback in chronic fatigue syndrome can provide significant reductions in fatigue (Fowler-Davis et al., 2021). These successful results give credit to the use of HRV with chronic fatigue and may then be useful in reducing anxiety in people who have fatigue due to Long Covid.

Use of Biofeedback as a Treatment Intervention for Anxiety

A systematic review of 227 articles, sixty-three of which met the criteria for biofeedback interventions for use with select psychiatric disorders, was conducted by researchers Schoenberg & David, 2014. Forty-three of those articles tested for efficacy with biofeedback and anxiety disorders. The biofeedback interventions included Electroencephalographic (EEG) and electromyographic (EMG). Three studies reported significant symptom reduction, whereby patients were able to consciously alter their heart rate which lowered anxiety. Forty-one articles reported a significant reduction in targeted symptoms related to biofeedback. Although the population did not include persons with Long Covid, the results of various biofeedback strategies on anxiety appear promising.

In a different study, 40 physicians (one primary care, thirty medical specialties, and nine surgical specialties) participated in using a biofeedback-based stress tool (Lemaire et al. (2011). This randomized control trial had the intervention group use a portable biofeedback stress management device (emWavePSR) three times per day along with twice-a-week support visits over 28 days. The control group received twice a week support from the research team. In addition, there was a 28-day extension period, where both the control and the intervention groups received the intervention, but without support from the research team. The biofeedback-based stress tool consisted of rhythmic breathing, self-generated positive emotions, and a portable biofeedback device to reduce physician stress. Results showed a significant decline in measured stress for the intervention group. The authors concluded that an average of 15 minutes per day of use of the stress management tool over four weeks may be sufficient to provide the benefit of stress relief. Even though stress was looked at in this study, anxiety many times co-exists with stress, therefore being applicable to the capstone study.

Occupational Therapy Intervention Using Biofeedback for Anxiety in Those with Long Covid

Many of the above studies looked at biofeedback in various diagnoses, as well as occupational therapy interventions addressing mental health and Long Covid. No specific articles were found examining HRV biofeedback to decrease anxiety in persons with Long Covid. This provides justification for the need for further research and identifies the gap in the current literature.

Summary

The capstone project will encompass using HRV biofeedback to aid in reducing anxiety in persons with Long Covid. In previous studies, positive results were found with the use of HRV biofeedback to reduce psychological effects including depression and anxiety (Fowler-Davis et al., 2021; Jester et al.,2019; Schoenberg & David, 2014). The article from Schoenberg & David (2014) did not have persons with Long Covid, however, it did provide good outcomes using HRV biofeedback. There is a need for neuropsychological programs and specific interventions such as mindfulness and breathing techniques for the Long Covid population suffering from anxiety (Braga et al., 2022, Sharma & Goswami, 2022). It is predicted that use of biofeedback will enable persons to decrease their anxiety and then more fully participate in occupations that are meaningful to them.

Completing this literature review allowed this author to obtain considerable background information on biofeedback, anxiety disorders, and Covid-19 disease progression that pertains to the capstone project. The various study design, protocols, and devices provided a better understanding of which methods to use. There was information on various cognitive and anxiety screening tools, as well as dosing and frequency for interventions which contributed to the design of the capstone project. The evidence overall was positive for use of HRV biofeedback on adults to decrease anxiety. In addition, evidence was positive for other non-pharmacological methods including mindfulness and psychoeducation as methods to reduce anxiety. The capstone project using a nonpharmacological approach with biofeedback can help close the research gap on the Long Covid population and those experiencing anxiety. In addition to closing the research gap, the capstone can provide guidance for best practices within occupational interventions. This article review gives validation for the need for further occupational therapy interventions to treat persons who have experienced ill effects from Long Covid.

Section III: Methodology

Project Design

This study was a one-group pretest-posttest quasi-experimental design study. Data collection was via pre- and post-assessments. The assessments included General Anxiety Disorder-7 (GAD-7) and the Quality-of-Life Scale (QOLS) which are described in the "assessment used" section below.

Research Questions

The aim of the study is to answer the questions:

1) Does occupational therapy treatment intervention using HRV biofeedback decrease anxiety in persons with Long Covid?
2) Does occupational therapy treatment intervention using HRV biofeedback increase the quality of life in persons with Long Covid?

Setting

The research study was conducted at a rehabilitation hospital, in the southern United States. This setting was chosen based on the convenience of location as this is the researcher's place of employment. In addition, past patients and employees recruited were familiar with this rehabilitation hospital. The setting allowed for research to be conducted in a quiet room. The study was conducted from December 2022 through April 2023. The IRB from Eastern Kentucky University was approved on November 28, 2022. A second location was added to allow for additional recruitment of participants. The IRB approved the researcher's home office on February 7, 2023.

Participants

Inclusion Criteria

To qualify for the study, participants were adults 18 years old or older who have had Long Covid, with anxiety lasting at least 3 months. Participants were recruited via 1) patients discharged from the rehabilitation hospital 2) individuals in the surrounding community 3) and employees of the rehabilitation hospital who self-reported having Covid 19 and symptoms of anxiety.

Exclusion Criteria

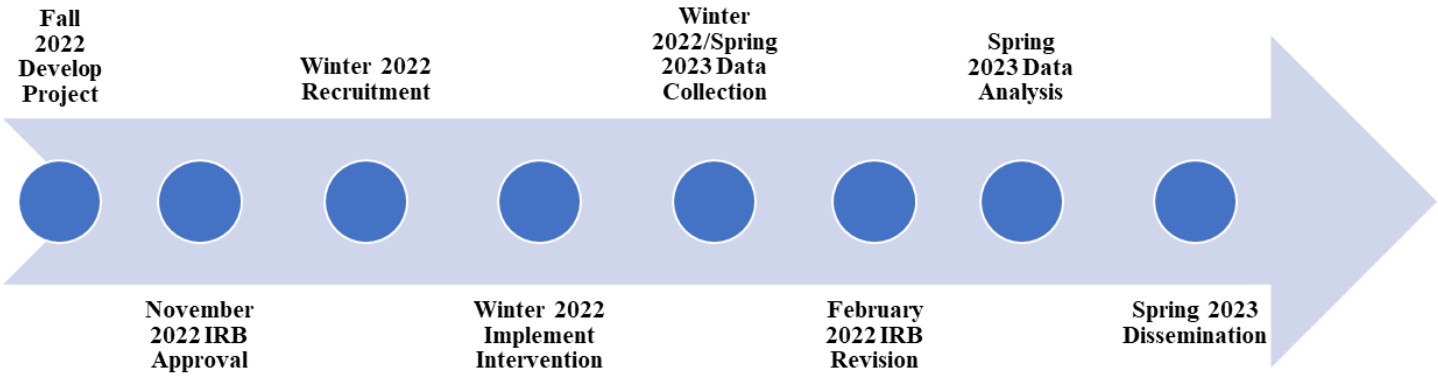
Participants were excluded if they received a Mini-Cog score of 3 or less. The Mini-Cog Test is a screening tool for dementia (Dementia Care Central, 2020). The Mini-Cog is made up of a three-word recall that looks at short-term memory and a clock test where verbal understanding, visual memory, planning, and abstract thinking are assessed (See Appendix A). The rationale for exclusion was based on the participants having the ability to recall and report their anxiety over four weeks as well as following directions within the intervention study.

Recruitment

Recruitment of participants included placing flyers in the rehabilitation hospital, emails to rehabilitation hospital staff, and collaboration with the director of nursing to identify past rehabilitation patients who have had Covid. Recruitment of participants was between December 1, 2022- March 15, 2023. To date, the rehabilitation hospital has not granted approval to see past patients, however when approval is given, the recruitment of these patients will be assessed. Due to the delay in approval, a second research site was proposed to the EKU IRB. Allowing a second site to conduct research provided for an increased number of participants. Approval of the revision was granted on February 7, 2023.

Figure 1. shows the timeline for the completion of the project including the following descriptors: development of the capstone proposal, IRB approval and revision, data collection and analysis, and dissemination of results.

Figure 1: Timeline



Research Methods

Data Collection

Participants were selected based on the inclusion and exclusion criteria. The study design was a pretest-posttest with one group. Once accepted into the study, each participant was given a unique numerical code to de-identify them. In the initial session, participants were screened for exclusion based on the Mini-Cog assessment. This screening tool was used to ascertain their ability to follow directions, recall anxiety levels, and have a good understanding of the intervention. Next, they were given the Generalized Anxiety Disorder-7 (GAD-7) and the Quality-of-Life Scale (QOLS) assessments as baseline measurements. Lastly, they were given a relaxation/breathing exercise as the intervention where physiological measurements were recorded. The design allowed for examining the change in the anxiety of individuals from the beginning of the study to the end of the study after the intervention is administered. Participants were originally scheduled for the intervention twice a week for four weeks, however, due to schedule conflicts and the holidays, 8 sessions were scheduled over time. Physiological measurements were collected at each session via software for use of viewing each session with the participant. The last session included a post-test of the GAD-7 and QOLS. See the intervention schedule table below.

Table 1: Intervention/Assessment Schedule

Intervention/Assessment Schedule

Week	Informed Consent	Mini-Cog	GAD-7	QOLS	Biofeedback	Notes
Week 1-S1	X	X	X	X	X	Note
Week 1-S2					X	Note
Week 2-S1					X	Note
Week 2-S2					X	Note
Week 3-S1					X	Note
Week 3-S2					X	Note
Week 4-S1					X	Note
Week 4-S2			X	X	X	Note

Note. S1-Session 1, S2-Session 2

Assessment Instruments

Mini-Cog

The three assessments used in this research include the Mini-Cog, the Generalized Anxiety Disorder 7 (GAD-7), and The Quality-of-Life Scale. The Mini-Cog (Appendix A) is a screening tool for cognitive deficits including dementia; it is made up of a three-word recall that looks at short-term memory and a clock test where verbal understanding, visual memory, planning, and abstract thinking are assessed citation. The Mini-Cog is a fast-screening tool that takes 5 minutes to administer (Dementia Care Central, 2020). Potential participants will be screened with the Mini-Cog test and excluded if they scored a 3 or less.

GAD 7

The Generalized Anxiety Disorder 7 (GAD-7) is a validated screening tool for generalized anxiety disorder within the general medical population (AOTA, 2011). The GAD-7 (Appendix B) has seven questions derived from the Diagnostic and Statistical Manual of Mental Disorders

(AOTA, 2011; Johnson et al., 2019). The assessment asks the rater to use the last two weeks as the timeline and how often the following items have been a bother to them. The seven items on the GAD-7 are “feeling nervous, anxious, or on edge”, “being able to stop or control worrying”, worrying too much about different things”, “trouble relaxing”, “being restless”, “becoming easily annoyed or irritable”, and “feeling afraid as if something awful might happen”. The responses scored from not at all (0), several days (1), more than half the days (2), nearly every day (3). A total score is then computed. Higher scores reflect greater anxiety severity (Johnson et al., 2019). Scores are depicted by their anxiety level as follows: GAD-7 score of 0-4 (none), 5-9 (mild), 10-14 (moderate), and 15-21 (severe). When analyzing mean scores, a decrease in the score indicates a decrease in anxiety; conversely, a mean score that increases would indicate an increase in anxiety (Lee et al., 2022). A minimal clinical difference of a 4-point change is considered clinically meaningful based on a study looking at the GAD-7 scores in medically authorized cannabis patients (Lee et al., 2022).

Quality of Life Scale

The Quality-of-Life Scale (QOLS) was developed by Flanagan in 1978 and has been widely used by researchers to gather quantitative quality-of-life information from people with chronic illnesses (Burckhardt et. al., 2003). The quality-of-life assessment (Appendix C) questions were derived from Flanagan interviewing over 3000 Americans, pertaining to their satisfaction with many different domains of life (Burckhardt et. al., 2003). The instrument has six conceptual domains of quality of life including physical well-being, relationships, social, and community activities, personal development, recreation, and independence to do for oneself (Burckhardt et. al., 2003). This standardized assessment has 16 questions and is quick to administer, being mindful of the participant’s time. Persons report their satisfaction based on a

seven-point scale. The seven responses range from most satisfaction to least satisfaction. The responses are as follows: delighted (7), pleased (6), mostly satisfied (5), mixed (4), mostly dissatisfied (3), unhappy (2), and terrible (1). Participants who gain 7 to 8 points on the QOLS correlate to 60% improved symptoms after treatment based on group means only. (Burckhardt & Anderson, 2003). According to the Burckhardt et al. study, the QOLS is a valid and reliable instrument for measuring the quality of life from the patient's point of view. A second study was implemented with authors Burckhardt, Liedberg, and Henricksson looking at the QOLS reliability and validity with Swedes who had fibromyalgia. This study yielded the same outcome giving validation for reliability and validity (Liedberg et al., 2005). In recent years, researchers Zucoloto & Martinez also found reliability and validity in using the QOLS with primary healthcare workers (Zucoloto & Martinez, 2019).

Biofeedback Intervention

For the biofeedback intervention part of this study, the Destress Solution™ system and the Heart Rate Variability Sensor were purchased from Thought Technology Ltd. The biofeedback intervention sessions used the finger sensor to measure heart rate variability, temperature, and skin conductance of the participant. A self-regulation training screen was utilized to teach relaxation through the Destress Solution™ software biofeedback.

The first intervention session included an overview of the biofeedback intervention which included assessing and reporting stress, self-regulation (biofeedback) training screens, and relaxation therapy exercises. The participant sat in a quiet room. A finger sensor was placed on the participant's finger and then the relaxation software will begin. The participant was able to see their heart rate, respiration, and temperature on the visual screen whereby they paced and

practiced their breathing. The intervention evaluated stress markers, taught stress management, and enhanced resilience via biofeedback self-regulation.

The participant was oriented to the visual screen and choose which relaxation exercise they would like to do. The five biofeedback intervention programs are listed below with explanations.

1. Guided relaxation- A recorded voice guided the participants into relaxation. The recorded voice instructed the participant to scan over their body and were asked to breathe slowly and evenly.

2. Learning Control: Heart Rate Variability & Breathing. This activity contains the four displays for education on breath control, teaching calm diaphragmatic breathing to increase heart rate variability, encouraging cardiovascular health, and to balance the autonomic nervous system. A) HRV Power with animation: this activity is for monitoring and training heart rate variability. Using slow, relaxed breathing leads to a low-frequency value (LF). A greater low-frequency value equals greater heart rate variability. When the low frequency is above 80%, the feedback animation starts. B) HRV, Arousal, & Temp Power: this activity monitors and trains arousal, temperature, and heart rate variability. The animation starts when LF% increases above 80%. When LF% is less than 80, the animation pauses. The animation is merged with music. C) HRV Power Game- When LF% is 50, the first star fills in and quiet music begins to play, when LF% = 60-70, the second and third star fills in; when LF% = 80, the heart fills in to signal that the client is doing very well along with music that becomes more upbeat. D) HRV line graph –This screen is for training and monitoring heart rate variability. Specifically using the finger sensor to measure inhalation/exhalation.

3. Paced Breathing. This activity has display screens that use a pacer for guiding breathing. The pacer is set to simulate a specific breathing rate, which the participant can follow with their own breathing. As the pacer's circle rises, the participant inhales. As the pacer's circle falls, the participant exhales. Paced breathing teaches the participant to breathe in and out following a slow, regular metronome-like visual guide and increasingly takes the person from their normal breathing rate, which may be high, to a much slower and more desirable resting respiration rate. Slow, regular breathing promotes relaxation and helps the parasympathetic nervous system to initiate.

4. Learning Control: Arousal. This exercise uses animations such as the four seasons of the year (winter, spring, summer, and fall) and space with stars and planets. When the participant is relaxed, their arousal would decrease, and the animation would start. If the arousal increased, the animation would stop.

5. Learning Control: Temperature. When the participant relaxes, the finger temperature goes up and an animation will play. There is a temperature line graph that changes colors based on whether the temperature is increasing (blue) or decreasing (pink).

Figure 2 below is an example of the review screen post-intervention exercise. Slow, regular breathing engaged the relaxation response and helped the parasympathetic nervous system take over. Idyllically, the researcher wanted to see the following changes as the session progressed: increases and decreases in the heart rate (red) line graph, and an increase in the low-frequency percent (green) for heart rate variability which occurs when the breathing rate decreases towards six breaths per minute. If arousal showed increasing values, it could indicate the amount of concentration the participant is giving to the exercise or an expression of their discomfort. If the arousal decreased, then it showed the participant was easing into the task.

Figure 2: Review Screen

Observational Notes

Notes were taken during sessions to record participants' statements and to reflect any adverse responses to the intervention. In addition, notes were taken to reflect any changes from the original timeline or protocol.

Ethical Considerations

The risks of participating in this study were no more than what is expected in daily life. The benefit of the study was an intervention to reduce anxiety. Once a participant acquires knowledge, this skill can be carried forward to improve the participants' quality of life. There was a potential risk of increased anxiety during initial assessments. To minimize this risk, a quiet relaxed atmosphere was provided when conducting all aspects of the study from recruitment

through the interventions. In addition, for the Rehab Hospital employees, there was a risk of peers discovering personal health information due to enrolling in the study. Full confidentiality of which employees were enrolled in the study and scheduling employee intervention times to avoid other colleagues were practiced.

A disclosed ethical consideration was the researcher was also the person who collected the informed consent, administered the treatment intervention and participated in analyzing the data. In order to reduce bias, the researcher assigned numbers to each participant and waited to analyze data until all participants had finished their eight sessions.

Informed Consent

All participants were given an informed consent form which included the statement that participation was voluntary. The primary investigator provided the informed consent form to each potential participant. Participants received ample time to read the informed consent in its entirety. Any questions were answered by the author, prior to participants signing the informed consent form. Each participant signed the informed consent before beginning the study.

Confidentiality

The code of autonomy states that occupational therapy practitioners must treat the research participants based on accepted standards of care, according to their wishes, and protect their confidential information (AOTA, 2020). All patient records were electronic, held on a password-protected tablet during the study, and then transferred to Eastern Kentucky University. The information will be held on a password-protected computer by the committee chair for three years and then the files will be deleted. All participants were de-identified with an individual number assignment. Finally, all electronic communication was encrypted to be in regulation with the Health Insurance Portability and Accountability Act.

Summary

The purpose of this study was to investigate the use of HRV biofeedback as an occupational therapy intervention. The objective was to reduce anxiety levels and improve the quality of life in persons with Long Covid. Occupational therapy practitioners have the knowledge to assist persons with various mental illnesses by teaching them strategies to improve their quality of life. The intent of this pilot study was to tentatively establish an effective non-pharmacological intervention to aid in evidence-based interventions to reduce anxiety in those with Long Covid. In addition, on a community level, the biofeedback tool may be able to reduce the frequency of medical visits, thus possibly decreasing medical costs to society.

Section 4: Results and Discussion

Results

Demographic Data

There was a total of eleven participants in this research study. Most of the participants were female 91 % (N=10) compared to 9% (N=1) male. Six participants reported being between the

ages of 18 to 39 years (55%) and 5 reported being between 40-59 years (45%). Of the 11 participants 45% reported having some college, 37% reported earning a master's degree and 18% reported earning a Doctorate degree. When asked about their current work status, 82% were actively working, one participant was retired, and one participant was on leave from their job (Table 2).

The focus of this study was examining Long Covid symptoms and concomitant anxiety symptoms. When asked how long the participants have had covid and anxiety symptoms, 37% of the participants reported having Covid 19 three-six months prior to participating in the study, 18% reported having Covid 19 six-twelve months prior and 45% of participants reported having Covid 19 12 + months before engaging in the study. Additionally, 18% of the participants reported having symptoms of anxiety for three-six months prior to the study, equally, there were 9% each reported having anxiety symptoms for six-twelve months and one-two years and finally, 64% of the participants reported having anxiety symptoms for over three years prior to the study (Table 3).

Table 2: Demographics

Age Range	Number of Participants	
18-39	55%	(N=6)
40-59	45%	(N=5)
60+	0%	(N=0)
Gender		
Male	9%	(N=1)
Female	91%	(N=10)
Do Not Wish to Specify	0%	(N=0)
Education		
Did not finish high school	0%	(N=0)
GED	0%	(N=0)
High school diploma	0%	(N=0)
College	45%	(N=5)
Masters	37%	(N=4)
Doctorate	18%	(N=2)
Employment		
Active	82%	(N=9)
Retired	9%	(N=1)
Unemployed	0%	(N=0)
Leave	9%	(N=1)

Table 3: Covid & Anxiety Symptoms

How long have you had Long Covid symptoms?		Number of Participants
3-6 months	37%	(N=4)
6-12 months	18%	(N=2)
12+ months	45%	(N=5)
How long have you had anxiety symptoms?		
3-6 months	18%	(N=2)
6-12 months	9%	(N=1)
1-2 years	9%	(N=1)
3+ years	64%	(N=7)

Data evaluation transpired by analyzing the descriptive statistics from the capstones' initial data. This included the pre-test/post-test scores for the GAD-7, GAD-7 severity levels and the Quality-of-Life Scale. The differences in all pre-test/post-test scores were evaluated and then the mean scores for the difference in scores were assessed. Continuation of the study will allow for more data, specifically at least 30 participants, and then paired-sample t-tests will be used to determine the statistical significance of the data.

The Generalized Anxiety Disorder pre- and post-scores are listed in Table 4. The GAD-7 is a validated screening tool for generalized anxiety disorder within the general medical population. Higher scores reflect greater anxiety severity. The mean score for the difference in score was 4.09.

Table 4: Pre-Test and Post-Test Scores for Generalized Anxiety Disorder 7

Client	GAD	D/C GAD	Differences
1001	13	11	2
1002	4	1	3
1003	15	9	6
1004	16	7	9
1005	8	0	8
1006	14	19	-5
1007	6	4	2
1008	6	4	2
1009	5	4	1
1010	12	1	11
1011	8	2	6
Mean	9.72	5.64	4.09

The GAD-7 scores can be ranked by severity levels as depicted in Table 5. The highest pre-GAD score was 16 which is considered severe anxiety and the lowest pre-GAD score was 4 which is in the none level (Lee et al., 2022).

Table 5: Pre-Test and Post-Test Scores for Total Participants' GAD Severity Levels

GAD-7 Severity Levels	Total Participants-Pre GAD	Total Participants Post GAD
0-4 (none)	1	7
5-9 (mild)	5	2
10-14 (moderate)	3	1
15-21 (severe)	2	1

Table 6 describes the change in GAD severity levels for each participant from their pre and post-test scores.

Table 6: Pre-Test and Post-test for GAD Severity Levels

Participant	Pre GAD Severity Level	Post GAD Severity Level
1001	Moderate	Moderate
1002	None	None
1003	Severe	Mild
1004	Severe	Mild
1005	Mild	None
1006	Moderate	Severe
1007	Mild	None
1008	Mild	None
1009	Mild	None
1010	Moderate	None
1011	Mild	None

Table 7 describes the GAD differences and averages between the participant's age groups and education levels. The 18-39 age group showed almost double the group difference improvement with the 40-59-year-olds group. The greatest improvement in GAD differences was in the college-educated group.

Table 7: GAD Differences and Averages Compared to Age and Education

Age	GAD Difference	Average
18-39 (N=6)	31	5.16
40-59 (N=5)	14	2.8
Education		
College (N=5)	29	5.8
Masters (N=4)	19	4.75
Doctorate (N=2)	-3	-1.5

The Quality of Life Scale scores are seen in Table 8. This assessment pertains to the participant's satisfaction with many different domains of life including physical well-being, relationships, social, and community activities, personal development, recreation, and independence to do for oneself (Burckhardt & Anderson, 2003). The mean score for the difference in score was 8.90.

Table 8: Pre-Test and Post-Test Scores for Quality of Life Scale

Client	Pre QOLS	Post QOLS	Differences
1001	73	78	5
1002	85	100	15
1003	68	83	15
1004	70	93	23
1005	91	105	14
1006	77	76	-1
1007	85	91	6
1008	68	76	8
1009	93	84	-9
1010	77	96	19
1011	101	104	3
Mean	80.72	89.63	8.9

Table 9 describes the QOLS differences and averages between the participant's age groups and education levels. The 18-39 age group showed more than triple the group difference improvement over the 40-59-year-olds. The greatest improvement in QOLS differences were in the college and master's educated group.

Table 9: QOLS Differences and Averages Compared to Age and Education

Age	QOL Difference	Average
18-39 (N=6)	76	12.66
40-59 (N=5)	22	4.4
Education		
College (N=5)	56	11.2
Masters (N=4)	38	9.5
Doctorate (N=2)	4	2

Discussion

Generalized Anxiety Disorder

Analysis of the GAD data in this pilot study provides positive outcomes with the pre- and post- GAD differences as a group. When analyzing mean scores, a decrease in the score indicates a decrease in anxiety; conversely, a mean score that increases would indicate an increase in anxiety (Lee et al., 2022). A minimal clinical difference of a 4-point change is considered clinically meaningful based on a study completed in 2022 looking at GAD-7 scores (Lee et al., 2022). The GAD group average point change in this capstone study was 4.09 which correlates to a positive outcome. Ten out of eleven participants showed a decrease in their anxiety scores, and one had an increase in their GAD scores. Five out of eleven participants individual scores were more than 4.0, signifying a clinically meaningful result. When looking at the pre- and post-scores

for GAD severity levels, eight out of eleven participants had a decrease in anxiety severity levels, and two out of eleven remained in the same severity level group; each of the two, however, decreased their score within the severity level, and only one out of eleven participants increased their severity level.

Analysis of the GAD group difference compared to age groups (18-39 & 40-59) revealed both groups showed improvement in their anxiety, with the younger age group having a greater improvement in scores. When examining the results for the GAD differences compared to education levels, it was found that the college group had the greatest change in scores, with the master's group having the second greatest change; both changes were clinically significant. Interestingly to note, the doctorate group (N=2) as a group, was in the negative for change. When looking at the two doctorate scores individually, one in fact did have an improvement in their anxiety; the other doctorate participant did not, which skewed the average. This doctorate participant, who did not experience an improvement in anxiety, reported to the researcher that the post-score decrease was attributed to a particularly stressful week. These findings are consistent with previous research results on biofeedback in the reduction of anxiety and psychiatric problems (Jester et al., 2019; Schoenberg & David, 2014). This capstone project had a similar design to the study conducted by Jester and colleagues in 2019; some participants received two sessions over four weeks. In addition to similar dosing and psychometric properties, both studies showed positive outcomes.

Quality of Life Scale

Persons with Long Covid experience neuropsychological problems including anxiety, brain fog, depression, and a decline in quality of life (Braga et al., 2022). An objective of this capstone project was to see if HRV biofeedback, implemented by an occupational therapist,

could improve a person's quality of life. The findings of the post-individual scores of the QOLS revealed that 82% of the 11 participants reported improved quality of life after completing the biofeedback interventions. Two people had a negative post-QOLS score; one of those participants had a one-point score change, which can be viewed as a neutral change. As a group, the QOLS score change average was 8.9, which can be considered a significant improvement. In a different study, change of seven to eight points on the QOLS correlated to a 60% improvement in systems after treatment, based on group means (Burckhardt & Anderson, 2003).

This capstone project yielded almost an equal number of participants per age group. There were six participants in the 18-39 age group and five in the 40-59 group. Group QOLS difference scores depict all persons showed improved quality of life after completing the study, with the greatest improvement made in the 18-39 age group. Examining QOLS differences by education level, it was discovered that the college group had the greatest change in improved quality of life. The master's group had the second greatest change, and the doctorate group showed the least change in the quality of life.

The results of this capstone project are consistent with previous research examining community engagement, physical activity, and leisure, to promote quality of life (Stav et al., 2012; Hatta, 2020). As mentioned previously, the capstone objective was to improve quality of life through anxiety reduction; in order to accomplish this objective, occupational therapy practitioners are at the core of meaningful engagement interventions such as leisure activities. In addition, occupational therapy practitioners have the skills and knowledge to help those with mental illnesses improve their quality of life using non-pharmacological interventions. Providing additional interventions will allow for optimal functional outcomes. Strengths of the capstone project included the utilization of standardized assessments (GAD-7 and QOLS) and the

consistency of one interventionist. Furthermore, positive outcomes of the study, as reported by participants, include improved control in stressful situations, better breath control, and an overall feeling of relaxation post-intervention.

Limitations

Limitations of the study include a small sample size yielding only one male. Most participants had similar education and ethnicity and were between the ages of 24-48. Therefore, the results cannot be generalized to all persons who have had Long Covid and anxiety. One threat to external validity could be the data collection period. Data was collected during one winter holiday season and an increase in depression and anxiety can be commonly experienced during the holidays (NAMI, 2020). Noise interruptions were common in the rehab hospital during intervention sessions; however, participants reported it was not distracting. The original intervention protocol was twice a week for four weeks. Due to the holidays and scheduling issues, the protocol was not accomplished; every participant, however, received eight intervention sessions. In addition, this capstone study only had one person as the primary investigator, interventionist and data analyzer.

Implications for OT Practice

The initial results of this pilot study are promising, as the group differences from pre- and post- GAD-7 and QOLS were clinically significant. There is a gap in research concerning HRV biofeedback as an occupational therapy intervention to reduce anxiety in persons with Long Covid. This research provides a useful intervention for occupational therapy practitioners to use to reduce anxiety in people with Long Covid. Biofeedback can be used as a preparatory intervention to help abate symptoms of anxiety, and therefore, allow the person to fully engage

in occupational therapy sessions. The results of this capstone study indicate that biofeedback can reduce anxiety and improve overall quality of life for those with Long Covid , within eight sessions.

Future Research

The initial results of this pilot study are promising, as the group differences from pre- and post- GAD-7 and QOLS were clinically significant. The capstone project resulted in only 11 participants. It is the hope of the researcher to continue recruiting after the capstone is completed. Having 30 or more participants would allow for parametric tests to be used with results possibly showing statistical significance. Additional research is needed to assess how a reduction in anxiety can impact not only quality of life, but also overall occupational performance. Because biofeedback is infrequently used in occupational therapy practice, it would be beneficial to determine which settings would be most impacted by this type of intervention. Lastly, future research looking at the delivery of biofeedback training via telehealth would help to decrease disparities such as accessibility to healthcare in rural America.

Conclusion

The purpose of the capstone project was to provide new research regarding the use of biofeedback to reduce anxiety in persons with Long Covid. This research is particularly useful for occupational therapy practitioners, as the investigator is an occupational therapist. The study revealed a decrease in anxiety and an increase in quality of life based on group mean scores. While this researcher found previous evidence connecting biofeedback intervention methods to anxiety reduction, little research exists on anxiety reduction via HRV biofeedback in persons with Long Covid. This research helps to fill gaps in the literature and provides a rationale for occupational therapy interventions focusing on anxiety reduction for those with Long Covid.

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Appendices

Appendix A

Mini- Cog Assessment

Mini-Cog©

Instructions for Administration & Scoring

ID: _____ Date: _____

Step 1: Three Word Registration

Look directly at person and say, "Please listen carefully. I am going to say three words that I want you to repeat back to me now and try to remember. The words are [select a list of words from the versions below]. Please say them for me now." If the person is unable to repeat the words after three attempts, move on to Step 2 (clock drawing).

The following and other word lists have been used in one or more clinical studies.[1-3] For repeated administrations, use of an alternative word list is recommended.

Version 1	Version 2	Version 3	Version 4	Version 5	Version 6
Banana	Leader	Village	River	Captain	Daughter
Sunrise	Season	Kitchen	Nation	Garden	Heaven
Chair	Table	Baby	Finger	Picture	Mountain

Step 2: Clock Drawing

Say: "Next, I want you to draw a clock for me. First, put in all of the numbers where they go." When that is completed, say: "Now, set the hands to 10 past 11."

Use preprinted circle (see next page) for this exercise. Repeat instructions as needed as this is not a memory test. Move to Step 3 if the clock is not complete within three minutes.

Step 3: Three Word Recall

Ask the person to recall the three words you stated in Step 1. Say: "What were the three words I asked you to remember?" Record the word list version number and the person's answers below.

Word List Version: _____ Person's Answers: _____ _____ _____

Scoring

Word Recall: _____ (0-3 points)	1 point for each word spontaneously recalled without cueing.
Clock Draw: _____ (0 or 2 points)	Normal clock = 2 points. A normal clock has all numbers placed in the correct sequence and approximately correct position (e.g., 12, 3, 6 and 9 are in anchor positions) with no missing or duplicate numbers. Hands are pointing to the 11 and 2 (11:10). Hand length is not scored. Inability or refusal to draw a clock (abnormal) = 0 points.
Total Score: _____ (0-5 points)	Total score = Word Recall score + Clock Draw score. A cut point of <3 on the Mini-Cog™ has been validated for dementia screening, but many individuals with clinically meaningful cognitive impairment will score higher. When greater sensitivity is desired, a cut point of <4 is recommended as it may indicate a need for further evaluation of cognitive status.

Appendix B

Generalized Anxiety Disorder 7

Over the last 2 weeks, how often have you been bothered by the following problems?	Not at all sure	Several days	Over half the days	Nearly every day
1. Feeling nervous, anxious, or on edge	0	1	2	3
2. Not being able to stop or control worrying	0	1	2	3
3. Worrying too much about different things	0	1	2	3
4. Trouble relaxing	0	1	2	3
5. Being so restless that it's hard to sit still	0	1	2	3
6. Becoming easily annoyed or irritable	0	1	2	3
7. Feeling afraid as if something awful might happen	0	1	2	3
Add the score for each column	+	+	+	
Total Score *(add your column scores)* =				

If you checked off any problems, how difficult have these made it for you to do your work, take care of things at home, or get along with other people?

Not difficult at all _____
Somewhat difficult _____
Very difficult _____
Extremely difficult _____

Developed by Drs. Robert L. Spitzer, Janet B.W. Williams, Kurt Kroenke and colleagues, with an educational grant from Pfizer Inc. No permission required to reproduce, translate, display or distribute.

Appendix C

Quality of Life Scale

Please read each item and circle the number that best describes how satisfied you are at this time. Please answer each item even if you do not currently participate in an activity or have a relationship. You can be satisfied or dissatisfied with not doing the activity or having the relationship.

	Delighted	Pleased	Mostly Satisfied	Mixed	Mostly Dissatisfied	Unhappy	Terrible
1. Material comforts home, food, conveniences, financial security	7	6	5	4	3	2	1
2. Health - being physically fit and vigorous	7	6	5	4	3	2	1
3. Relationships with parents, siblings & other relatives- communicating, visiting, helping	7	6	5	4	3	2	1
4. Having and rearing children	7	6	5	4	3	2	1
5. Close relationships with spouse or significant other	7	6	5	4	3	2	1
6. Close friends	7	6	5	4	3	2	1
7. Helping and encouraging others, volunteering, giving advice	7	6	5	4	3	2	1
8. Participating in organizations and public affairs	7	6	5	4	3	2	1
9. Learning- attending school, improving understanding, getting additional knowledge.	7	6	5	4	3	2	1
10. Understanding yourself - knowing your assets and limitations - knowing what life is about.	7	6	5	4	3	2	1
11. Work - job or in home	7	6	5	4	3	2	1
12. Expressing yourself creatively	7	6	5	4	3	2	1
13. Socializing - meeting other people, doing things, parties, etc	7	6	5	4	3	2	1
14. Reading, listening to music, or observing entertainment	7	6	5	4	3	2	1
15. Participating in active recreation	7	6	5	4	3	2	1
16. Independence, doing for yourself	7	6	5	4	3	2	1