THE INFLUENCE OF MUSIC-ASSISTED COPING STRATEGIES ON DYSPNEA, ANXIETY, AND SELF-EFFICACY FOR PATIENTS IN HOME CARE OCCUPATIONAL THERAPY: A FEASIBILITY STUDY

By

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Abstract

Review of Literature: Current dyspnea research shows a need for more investigation of non-pharmacologic interventions that promote self-efficacy, address multiple dimensions of dyspnea, and help disrupt dyspnea-anxiety cycles. Clinical studies and emerging information on the neurophysiological effects of music show evidence and potential mechanisms for music to enhance dyspnea self-management strategies.

Methods: The researchers recruited participants receiving home care occupational therapy for dyspnea management. Participants received an audio compact disc with verbal cues for guided relaxation and breathing techniques, with or without supportive music based on random assignment. Participants were asked to complete Modified Borg Dyspnea Scales for dyspnea intensity and unpleasantness (MBDS-I and MBDS-U) and a Subjective Units of Distress Scale (SUDS) before and after each practice period, as well as a Self-Efficacy for Managing Chronic Disease 6-Item Scale (SECD6) at the beginning and end of the treatment period.

Results: Three participants initiated the study, and data was collected for one participant with COPD (n=1). The pre-treatment SECD6 reflected moderate self-efficacy, and a post-treatment SECD6 was not collected. The MBDS-I, MBDS-U, and SUDS showed consistent decreases between pre- and post-intervention (mean decrease of 1.4 points in dyspnea intensity, 1.9 points in dyspnea unpleasantness, and 3 points in subjective distress).

Discussion: Though the data showed decreases in dyspnea and anxiety, the sample size was too small to interpret the results. The study revealed potential improvements for future research.

Keywords: dyspnea, occupational therapy, coping strategies, self-management, music intervention, breathing, relaxation

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Introduction

The human body has evolved to protect breathing, one of the most essential processes for survival. The brain is wired to safeguard against immediate respiratory threats, such as choking, drowning, and asphyxiation. However, in modern industrialized societies, millions of people face life-limiting illnesses that impede their breathing on a persistent basis. According to projections by the World Health Organization, the global burden of chronic diseases such as chronic obstructive pulmonary disease (COPD), cancer, and heart disease is expected to rise significantly by 2030 due to the aging of the global population (World Health Organization, 2004). For people experiencing these diseases, the body's natural defense mechanisms can become maladaptive and contribute to one of the most challenging symptoms faced by patients, families, and the healthcare system: dyspnea, also known as breathlessness.

The American Thoracic Society (ATS) defines dyspnea as "a subjective experience of breathing discomfort that consists of qualitatively distinct sensations that vary in intensity," and states that dyspnea "derives from interactions among multiple physiological, psychological, social, and environmental factors, and may induce secondary physiologic responses" (Parshall et al., 2012, p. 436-437). In 2008, Abernethy & Wheeler introduced a model of "total dyspnea," based on Dame Cicely Saunders' concept of "total pain," emphasizing the multidimensional nature of the symptom. Like pain, breathlessness is a complex symptom with physical, psychological, social, and spiritual aspects; it is also challenging to treat and imposes significant burdens on patients, families, and healthcare systems. For patients with chronic lung diseases, dyspnea is more likely than lung function to predict poor quality of life, hospitalization, and mortality (Kamal, Maguire, Wheeler, Currow, & Abernethy, 2011; Parshall et al., 2012). Dyspnea has been correlated with decreased family wellbeing and increased medical staff anxiety, and is the fourth most common reason palliative care patients visit the emergency room (Kamal et al., 2011). Nearly a quarter of ambulance use and up to half of admissions to acute, tertiary care hospitals are related to dyspnea (Parshall et al., 2012). Medicare expenses for patients with COPD are about 2.5 times greater than all other Medicare recipients, and about 70% of their medical costs are related to dyspnea exacerbations (National Heart, Lung, and Blood Institute/World Health Organization, 2006; Niewoehner, 2006).

Recent developments in neurophysiological research have been consistent with the concept of "total dyspnea," showing that the processes of dyspnea perception in the brain are intricately connected with neural networks involved in anxiety, emotion, attention, and learning. These findings support the need for interdisciplinary treatment strategies that help patients cope with the affective dimensions of dyspnea as well as the physical sensations (Parshall et al., 2012). In the most recent ATS official statement on dyspnea, Parshall et al. (2012) state:

> Finally, more than at any time in the past, there is a need for interdisciplinary approaches to research into dyspnea mechanisms and treatments that will accelerate translation of research findings into clinical practice. It is still too often the case that studies of dyspnea mechanisms and treatments are siloed by disease or by specialty or disciplinary focus. Studies of treatments such as pulmonary or cardiac rehabilitation, for example, as well as behavioral treatments that have the potential to be relevant to multiple conditions, have tended to be limited to a

> particular diagnosis or specialty. Given the difficulty of controlling dyspnea in many patients with chronic medical problems, we encourage increased communication and collaboration between medical and palliative specialists and among clinicians and researchers across other specialties and disciplines (p. 445).

With the global rise in chronic diseases, health care professionals will need to work together to broaden the repertoire of interventions for dyspnea and other challenging symptoms.

As healthcare policy changes shift more of the treatment for chronic conditions to home and community settings, there is a growing need for interventions that promote dyspnea self-management and support family caregivers. These interventions are often provided within pulmonary rehabilitation and self-management programs, in which patients and caregivers receive treatment, education, and support from interdisciplinary teams that address multiple components of dyspnea (Zwerink et al., 2014). Currently, fewer than 15% of patients with chronic dyspnea receive rehabilitation or self-management services; most dyspnea patients are treated with drugs and medical devices alone (Stellefson, Tennant, & Chaney, 2012). However, there is a growing interest in pulmonary rehabilitation and self-management programs as research shows their benefits. A Cochrane review including 14 clinical trials showed that self-management education significantly predicted fewer hospital admissions and higher quality of life measures for patients with COPD (Effing et al., 2009). Another Cochrane review of 23 studies of COPD patients found that self-management education had statistically significant effects on improving health-related quality of life and decreasing dyspnea scores and respiratory-related hospitalizations (Zwerink et al., 2014). Both reviews reveal a broad variety of interventions and delivery methods among pulmonary rehabilitation and self-management programs, and point to a need for more research to determine the best content and structures.

Pulmonary rehabilitation and self-management programs involve non-pharmacologic interventions in addition to drugs and medical equipment. Coping strategies are a crucial subset of non-pharmacologic interventions for patients with dyspnea. In pulmonary rehabilitation and self-management programs, clinicians use non-pharmacologic interventions to help patients and caregivers identify, practice, and expand their repertoire of coping strategies to decrease the impact of dyspnea on their quality of life, increase activity tolerance, improve self-efficacy, and reduce the need for emergency medical treatment (Effing et al., 2009; Stellefson et al., 2012). However, more research is needed to establish clinical evidence and identify best practices for these interventions (Bausewein, Booth, Gysels, & Higginson, 2008; Disler et al., 2012; Parshall et al., 2012).

Music-assisted interventions are a promising category of non-pharmacologic treatment strategies for dyspnea (Bradt & Dileo, 2014; Han et al., 2010; Korhan, Khorshid, & Uyar, 2012; Lee, Chung, Chan, & Chan, 2005; Panigrahi, Sohani, Amadi, & Joshi, 2014). Music has the potential to strengthen the effectiveness of coping strategies for dyspnea, including controlled breathing techniques, relaxation techniques, and distraction from respiratory stimuli (Bausewein et al., 2008; Louie, 2004; Mandel, Hanser, & Ryan, 2010; Robb, 2000; Singh, Rao, Prem, Sahoo, & Keshav, 2009). Music has powerful effects on the brain's processes of emotion, arousal, attention, memory, learning, and rhythmicity (Altenmüller, Siggel, Mohammadi, Samii, & Münte, 2014; Bernatzky, Presch, Anderson, & Panskepp, 2011; Chanda & Levitin, 2013; Dobek, Beynon, Bosma, & Stroman, 2014; Fancourt, Ockelford, & Belai, 2014; Krout, 2007; Norweg & Collins, 2013; Thaut, 2002; Thaut, 2013).

It is important to make a distinction between music intervention and music therapy. The American Music Therapy Association defines music therapy as “the clinical and evidence-based use of music interventions to accomplish individualized goals within a therapeutic relationship by a credentialed professional who has completed an approved music therapy program” (American Music Therapy Association, n.d.). Music therapists are extensively trained to facilitate a variety of therapeutic music experiences based on individual assessment, often including active music making, within a supportive therapeutic relationship (American Music Therapy Association, n.d; Bradt & Dileo, 2014). However, outside of music therapy, other clinicians, caregivers, and patients can use music interventions therapeutically (Craig, 2008; Dahlin, 2006; Metzger, 2004). Recorded music can be a simple, adaptable, cost-effective, enjoyable, and effective therapeutic tool. Preliminary studies have found evidence that interventions using recorded music can improve treatment outcomes for patients with dyspnea; however, more research is needed to provide evidence and develop models for therapeutic uses of music in treating breathlessness (Bausewein et al., 2008; Panigrahi et al., 2014). As clinicians, consultants, and researchers, music therapists can be a resource for pulmonary rehabilitation and self-management teams, collaborating and contributing to the expansion of effective interventions for breathlessness (Bradt & Dileo, 2014; Chen, 2004; Clair & Memmott, 2008).

The current feasibility study is an interdisciplinary effort to design and evaluate a simple music-assisted self-management intervention for home care patients receiving occupational therapy for dyspnea. The development of the intervention emerged from an analysis of contemporary research on music interventions and other non-pharmacologic treatments for breathlessness. The review covers a summary of the neurologic and psychosocial processes of dyspnea, current treatment protocols, and developments in pulmonary rehabilitation and self-management programs, including non-pharmacologic interventions. Additionally, it includes an outline of current research on music interventions for dyspnea, descriptions of relevant neurologic and therapeutic effects of music, and challenges of music as a treatment modality. The review of literature illustrates the need for interdisciplinary collaboration to develop therapeutic applications of music for dyspnea rehabilitation and self-management.

Review of Literature

Overview

Contemporary research shows that dyspnea is a multidimensional symptom that includes physical, emotional, social, and spiritual processes, and that it is managed most effectively with multidimensional treatment strategies (Effing et al., 2009; Parshall et al., 2012; Stellefson et al., 2012; Zwerink et al., 2014). Currently, dyspnea is most often treated exclusively with pharmaceuticals and medical devices (Stellefson et al., 2012). Although these medical technologies are essential, they often cannot address the psychosocial and behavioral factors that exacerbate dyspnea and its deleterious effects on quality of life (Blumenthal et al., 2009; Parshall et al., 2012). Music has the potential to influence multiple dimensions of dyspnea through its complex effects on emotion, arousal, attention, memory, learning, and rhythmic activity, as well as its social, spiritual, and practical qualities (Altenmüller et al., 2014; Bernatzky et al., 2011; Chanda & Levitin, 2013; Dobek et al., 2014; Fancourt et al., 2014; Krout, 2007; Norweg & Collins, 2013; Thaut, 2002; Thaut, 2013). While there is some promising clinical evidence for music interventions in dyspnea management, more research is needed to develop and evaluate effective uses of music for patients with dyspnea (Bausewein et al., 2008; Bradt & Dileo, 2014; Louie, 2004; Mandel et al., 2010; Panigrahi et al., 2014; Robb, 2000; Singh et al., 2009). Due to the complexity of dyspnea, this research may require benefit from interdisciplinary collaboration (Parshall et al., 2012).

Dyspnea: Descriptions and Causes

Dyspnea is a symptom that shares many properties with pain. They are both multidimensional, distressing sensations that evolved to protect the body from harm and preserve homeostasis. Like pain, dyspnea is a subjective phenomenon that can only be measured by self-report. Dyspnea does not directly correlate with respiratory rate, oxygen saturation, or lung function. Several different physical causes can contribute to dyspnea. When the cause itself is not treatable, treatment is focused on alleviating the suffering caused by the symptom (Glennon & Seskevich, 2008; Peiffer, 2009). The intensity and impact of dyspnea is mediated by patients' emotional states, behavior patterns, and social and cultural factors (Parshall et al., 2012; Ries, 2006).

Patients' descriptions of dyspnea vary widely; most tend to relate to "chest tightness," "air hunger," or "breathing effort" while some patients experience breathlessness as "throat tightness" or "blocked chi" (de Peuter et al., 2004; Ries, 2006). Many patients experience a combination of these sensations. These subjective descriptions are typically related to different physiological antecedents and warrant different treatment strategies. "Chest tightness" tends to relate to stimulation of vagal nerve receptors that detect congestion, restriction, or irritants in the airway. For example, a patient with lung cancer may experience chest tightness resulting from tumor-related airway obstruction. "Air hunger" usually pertains to imbalances in blood gas levels, when chemoreceptors in the blood vessels detect high carbon dioxide levels (i.e., hypercapnea) or low carbon dioxide or oxygen levels (i.e., hypocapnia or hypoxia) in the bloodstream. For example, a patient with congestive heart failure may experience air hunger related to inadequate circulation of oxygen. "Respiratory effort" corresponds with activity of mechanoreceptors in the chest wall that report respiratory muscle activity, responding to increased load, bronchoconstriction, or hyperinflation (del Fabbro, Dalal, & Bruera, 2006; Parshall et al., 2012; de Peuter et al., 2004). For example, patients with neuromuscular disorders may experience increased respiratory effort as their respiratory muscles weaken and need to work harder to support adequate ventilation.

Dyspnea is often connected with abnormal patterns in respiratory muscle activity. In healthy breathing, the diaphragm and external intercostal muscles contract during inhalation and rest during exhalation. Dyspnea often involves effort from accessory muscles for both inhalation and exhalation, including the sternocleidomastoid, trapezius, and abdominal muscles. The use of these accessory muscles for breathing can cause muscle fatigue and stimulate the “fight or flight” response of the sympathetic nervous system. However, patients’ optimal respiratory muscle patterns depend on their diagnosis and individual needs. For example, COPD patients with dynamic hyperinflation have lost elastic recoil in the lung and chest wall and flexibility in the diaphragm, causing them to depend on accessory muscles for respiration (Campbell, 2004; Gosselink, 2003, Janssens, de Muralt, & Titelion, 2000; de Peuter et al., 2004).

The respiratory muscles are unique in that they are controlled by both involuntary motor centers in the most primitive, innermost area of the brain, known as the brainstem, and voluntary motor centers in the most advanced, outermost layer of the brain, known as the cortex (Campbell, 2004; von Leupoldt & Dahme, 2005; Parshall et al., 2012). Involuntary breathing patterns are essential for the body to maintain metabolic homeostasis. The rhythm of involuntary breathing is generated in brainstem structures known as the medulla and pons, especially in a newly identified area called the pre-Bötzinger complex, in which the nerve firing activity appears chaotic and unpredictable, but combines in complex ways to produce regular breathing patterns. This stochastic process allows respiration to remain stable through a wide variety of conditions (Carroll & Ramirez, 2012; Ramirez, 2011).

In contrast, voluntary breathing centers in the motor cortex are connected with respiratory muscles through a rapid-acting nerve system, which allows for the intricate coordination of speech, singing, emotional changes in breathing, controlled breathing practices, and many other functions (von Leupoldt & Dahme, 2005; Ramirez, 2011). These two respiratory rhythm centers are integrated in complex ways. For example, while the respiratory rhythm center in the brainstem sends rhythmic signals down to the respiratory muscles, it also sends a copy of these signals up to the cortex. This copy, known as corollary discharge, plays an important role in dyspnea. When the cortex detects a mismatch between the expected breathing pattern from the brainstem and the ascending information from respiratory mechanoreceptors, this discrepancy stimulates the drive for voluntary breathing and intensifies the sensation of respiratory effort (von Leupoldt et al., 2008; Parshall et al., 2012).

Sensory and Affective Dimensions of Dyspnea

Dyspnea, like pain, involves two components: intensity (sensory dimension) and unpleasantness (affective dimension). These aspects of dyspnea are interrelated, but can be measured and modulated independently of each other. A study of healthy participants breathing through resistive loads found that the unpleasantness of dyspnea, but not the intensity, was influenced by distraction and emotional states (von Leupoldt, Mertz, Kegat, Burmester, & Dahme, 2006). When the affective dimension of dyspnea is managed, an individual may be short of breath but not bothered by it. In fact, many people learn to cope with declining respiratory function while experiencing relatively little distress (von Leupoldt et al., 2006; von Leupoldt, Seemann, Gugleva, & Dahme, 2007; Parshall et al., 2012). The ATS currently recommends that clinicians and researchers measure and treat both the sensory and affective dimensions of dyspnea (Parshall et al., 2012).

Brain imaging studies have found that sensory and affective dimensions of dyspnea are processed through two distinct neural pathways, which overlap with corresponding pathways of pain processing (von Leupoldt & Dahme, 2005; von Leupoldt, Seemann, et al., 2007). When sensory signals from the chest and airway ascend to the brainstem, they are projected to the thalamus, a structure of the midbrain that processes sensory information. Through the sensory pathway, signals are sent to ventral posterior areas of the thalamus, which forward the information to the somatosensory cortex (von Leupoldt & Dahme, 2005). The affective pathway, on the other hand, is more elaborate. Through this pathway, signals are sent to the medial dorsal area of the thalamus, and then projected to the anterior insula, an area of the brain that subjectively evaluates potentially distressing conditions. Signals from the anterior insula activate networks in the limbic system, a complex group of brain structures that process emotion, memory, and behavior. Limbic structures connected with the affective pathway of dyspnea include the anterior cingulate cortex (ACC) and amygdalae. The ACC plays a role in modifying attention and emotion in response to distressing stimuli, and the amygdalae are involved in processing emotion, particularly fear. These structures send signals to the hypothalamus, a limbic structure that activates the body's "flight or fight" response via the sympathetic nervous system. This affective pathway leads to heightened anxiety, which is a very common experience for dyspneic patients (von Leupoldt, Seemann, et al., 2007; von Leupoldt et al., 2008).

Dyspnea and Anxiety: A Vicious Cycle

Anxiety and dyspnea are intricately interwoven in the nervous system. Anxiety has a direct connection with respiratory rhythm, correlating with elevated respiration rate and decreased expiratory time relative to inspiratory time (Masaoka & Homma, 1999). In anxious states, a signal called a respiratory-related anxiety potential (R-RAP) is sent to the pre-Bötzinger complex through the periaqueductal grey, an area of the midbrain that processes panic and terror. This signal results in fear-related changes in breathing rhythm, including rapid respiratory rate (i.e., tachypnea) and hyperventilation. In most individuals, R-RAPs begin in the temporal poles, areas of the cortex that evaluate conditions of uncertainty. However, in individuals with high trait anxiety, R-RAPs originate in the amygdalae, structures in the limbic system that process fear and emotion (Homma & Masaoka, 2008).

Anxiety also has a direct effect on sensations of breathlessness by influencing sensory gating and learning processes. Sensory gating involves a network of several cortical and subcortical structures that filters redundant sensory stimuli. Under anxious conditions, sensory gating is lowered. Like individuals with post-traumatic stress disorder who are unable to "tune out" repetitive stimuli, many patients with dyspnea-related anxiety experience amplified respiratory sensations (Chan, von Leupoldt., Bradley, Lang, & Davenport, 2012). Over time, the individual's emotions, attention, and behaviors have a profound effect on the sensation of dyspnea. Through repeated experiences with breathlessness, a new neural pathway can develop involving memory, learning, and emotional processes that lead to dyspnea sensations regardless of the physical state of the respiratory system (von Leupoldt & Dahme, 2005).

The anxiety components of dyspnea serve a protective evolutionary purpose. When activated by stimuli that the limbic system evaluates as distressing, the sympathetic nervous system increases muscle tension, elevates blood pressure, accelerates heart rate and respiratory rate, and activates respiratory accessory muscles to prepare the body for “fight or flight.” This response is adaptive when the individual needs to escape an immediate asphyxiation threat (e.g. swim to the surface or break away from a choking hazard) (Campbell, 2004; Peiffer, 2009). However, when dyspnea sensations result from a chronic disease process, the anxiety response is not helpful, and a positive feedback loop of dyspnea and anxiety can develop. The sympathetic nervous system responds to a perceived threat, but the threat does not pass, and the body remains in “fight or flight” mode. Skeletal muscles remain tense, demanding more oxygen from an already compromised respiratory system. Respiratory accessory muscles continue to work harder and become more fatigued. The physical and neurological processes of anxiety amplify the sensation of dyspnea, which then causes more anxiety. Dyspnea and anxiety aggravate each other, creating a vicious cycle (Glennon & Seskevich, 2008; Kamal et al., 2011; Taylor, 2007). Without intervention to interrupt the cycle, this process can escalate into a dyspnea crisis resulting in hospitalization (Malik, Gysels, & Higginson, 2013; Mularski et al., 2013).

While anxiety exacerbates the sensations of dyspnea, it can also contribute to another vicious cycle of avoidance, deconditioning, and isolation. As patients experience dyspnea with exertion, anxiety about dyspnea may lead them to avoid levels of physical activity that would be safe and appropriate for them, which over time causes deconditioning and increased dyspnea at even lower levels of exertion (von Leupoldt & Dahme, 2007; Parshall et al., 2012). Sleep disturbances caused by anxiety may also bring about fatigue and further avoidance (Dahlin, 2006). Dyspnea-related anxiety causes some people to avoid social activity, leading to isolation and loss of social support (Williams, Bruton, Ellis-Hill, & McPherson, 2010).

Caregivers

Caregivers can also be caught up in the vicious cycles of dyspnea and anxiety. As healthcare systems transition to a more community-based approach, family caregivers are playing a larger role in the care of patients with chronic diseases; however, their needs typically go unmet (Malik et al., 2013; Moody & McMillan, 2003). Breathlessness is a particularly distressing symptom to observe, and often causes feelings of helplessness for caregivers. Caregivers report having few effective strategies to ameliorate the suffering of dyspnea, and their attempts to help are not often received as beneficial for the person struggling with breathlessness. This can lead to irritation and heightened anxiety for both the patient and caregiver (Gysels & Higginson, 2009). Caregiver anxiety may compound the anxiety of the patient, contributing to worsening breathlessness. When patients and caregivers are unprepared to cope with exacerbations, these situations become a crisis in which caregivers struggle to judge when to call for emergency care (Gysels & Higginson, 2009; Mularski et al., 2013). Caregivers of breathless patients are at risk of decreased physical, psychological, and social health, which in turn diminishes patients' wellbeing (Blumenthal et al., 2009; Gysels & Higginson, 2009).

Grief and Spiritual Distress

Patients with dyspnea, as well as their caregivers, may be grieving significant losses. These losses may include loss of independence, valued personal roles, social support, and dreams and plans for the future. Patients may be grieving the ability to participate in activities that gave their life joy and meaning. Many report feelings of helplessness, hopelessness, fear, and spiritual or existential distress (Abernethy & Wheeler, 2008; Malik et al., 2013; O'Driscoll, Corner, & Bailey, 1999; Parshall et al., 2012). Some patients experience breathlessness as a powerful reminder of their mortality. The psychosocial and spiritual dimensions of dyspnea are complex and unique for each individual (Abernethy & Wheeler, 2008; Malik et al, 2013; O'Driscoll, Corner, & Bailey, 1999; Parshall et al., 2012).

Depression and Anxiety Disorders

Dyspnea-related diagnoses, particularly obstructive pulmonary diseases, have high comorbidity rates with depression and anxiety diagnoses. Likewise, patients with underlying depression and anxiety disorders tend to report worse dyspnea and have poorer treatment outcomes (Kamal et al., 2011; von Leupoldt & Dahme, 2007; Norweg & Collins, 2013). These psychological comorbidities are significantly associated with more frequent inpatient admissions, longer hospital stays, higher relapse rates after emergency treatment, lower quality of life, and reduced survival (Putnam-Casdorph & McCrone, 2009).

In spite of their harmful effects on individuals, families, and healthcare systems, the psychosocial symptoms related to dyspnea are most often untreated (Blumenthal et al., 2009). In a healthcare environment where medical professionals are more rushed than ever, providers may not have time to evaluate emotional needs, and patients may be reluctant to discuss their feelings and fears (Putnam-Casdorph & McCrone, 2009). In a qualitative study, many COPD patients reported feeling frustrated that clinicians seem to have little understanding of what it is like to live with dyspnea (Booth, Silvester, & Todd, 2003).

Dyspnea Interventions

Pharmacologic interventions. Dyspnea is currently treated primarily through pharmaceuticals and medical devices, which play an essential role in reducing many patients' suffering. Opioids are the principal drugs used to relieve breathlessness. Though their mechanism is unknown, they most likely work by modulating brain activity in ways similar to their role in pain management, and by depressing ventilatory drive (Parshall et al., 2012). Corticosteroids can reduce airway inflammation for some patients (Janssens et al., 2000). Bronchodilators reduce dyspnea by relaxing the muscles around the airways (Putnam-Casdorph & McCrone, 2009). Methylxanthines decrease dyspnea in COPD patients; though their mechanism is also unknown, they may have an effect on respiratory muscles that supports lung expansion (Dahlin et al., 2006; Janssens et al., 2000). Nebulized furosemide may help relieve breathlessness by affecting vagal afferent signals (Parshall et al., 2012). Oxygen therapy can reduce antecedents of dyspnea by stimulating airflow receptors in the upper airway or altering blood gas levels (del Fabbro et al., 2006; Parshall et al., 2012). Some patients with COPD and neurologic disorders may benefit from mechanical ventilation to relieve the muscular effort of breathing (Janssens et al., 2000). Occasionally, benzodiazepines are used to treat dyspnea-related anxiety, but they are often avoided due to risks of impeding respiratory function and increasing carbon dioxide levels in the bloodstream (Blumenthal et al., 2009; Janssens et al., 2000; Reddy, Parsons, Elsayem, Palmera, & Bruera, 2009). While pharmacologic treatments are important therapeutic tools, drugs and devices alone are often insufficient to ameliorate breathlessness (Bausewein et al., 2008). The ATS states that currently no pharmaceuticals are effective enough to receive Food and Drug Administration approval to specifically treat dyspnea (Parshall, 2012).

Non-pharmacologic interventions. Used together with pharmacologic treatments, non-pharmacologic interventions have potential to improve outcomes for patients with dyspnea. However, research, development, acceptance, and standardization of these interventions are challenging. Evidence for non-pharmacologic treatments is often unclear due to variation of protocols and individual responses (Bausewein et al., 2008). Non-pharmacologic interventions often involve learning new skills and changing established response patterns, and thus require motivation to be effective. Additionally, there are no corporations with a financial interest in demonstrating the efficacy of non-pharmacologic treatments; therefore, most of the research and development of coping strategies for dyspnea must come from academic and clinical settings (Booth, Moffat, Burkin, Galbraith, & Bausewein, 2011). Some non-pharmacologic interventions have some preliminary support from small studies; these include distraction, relaxation, and breathing techniques, electric fans, chest wall vibration, neuromuscular electrical stimulation, and acupressure, and acupuncture (Bausewein et al., 2008; Booth et al., 2011; Disler et al., 2012). There is a need for more research to establish the effectiveness and best practices for these techniques (Bausewein et al., 2008; Disler et al., 2012).

Pulmonary rehabilitation and self-management programs. Non-pharmacologic interventions often work together with pharmaceutical treatments in pulmonary rehabilitation and self-management programs. These programs address the psychological and social dimensions of breathlessness along with the physical dimension. Pulmonary rehabilitation and self-management teams may include physicians, nurses, respiratory therapists, physical therapists, occupational therapists, social workers, dieticians, and other clinicians. The components of treatment vary widely, but they typically include management of medications and devices, exercise training to help desensitize patients to breathlessness, patient and family education in disease management, counseling, and enhancement of coping strategies. These methods help patients and caregivers learn to disrupt the cycles of breathlessness, anxiety, avoidance, deconditioning, and isolation (Effing et al., 2009; Zwerink et al., 2014). Patients gain confidence in their ability to manage their dyspnea, a concept known as self-efficacy. Self-management programs are found to significantly improve self-efficacy for patients with COPD, and higher self-efficacy scores are significantly related to improved activity levels and quality of life, as well as decreased healthcare utilization (Stellefson et al., 2012). Many patients and caregivers report that self-management strategies help renew their sense of hope while coping with chronic disease (Norweg, Bose, Snow, & Berkowitz, 2008; Williams et al., 2010).

There are growing opportunities for individuals to learn coping strategies in the community, such as gentle exercise, relaxation, and breathing practices. There is an abundance of books, recordings, smartphone apps, yoga classes, meditation groups, stress management programs, and other wellness resources available to support self-management techniques. While people ith dyspnea can certainly benefit from these resources, they also may need to learn and practice self-management strategies with healthcare professionals who are knowledgeable about the disease processes and individual patient's needs. These professionals can help patients problem-solve and safely build their repertoire of coping skills (Apps et al., 2014; Christenberry, 2005; Norweg & Collins, 2013). Many patients and caregivers affected by dyspnea report that the supportive relationships with their healthcare professionals are an important factor in their treatment (Booth et al., 2011; Gysels & Higginson, 2009; Parshall et al., 2012).

To be effective, non-pharmacologic interventions for dyspnea need to be individualized, presented within a trusted relationship, and adjusted as needed over time. The clinician must listen to the patient and caregiver, attend to each individual's unique experiences with dyspnea, and provide a safe space to address anxieties and fears (O'Driscoll et al., 1999; Taylor, 2007). Non-pharmacologic treatments must be appropriate for the patient's level of functioning, prognosis, resources, values, motivation, cognition, and ability to concentrate and learn new skills. Patients with mild to moderate dyspnea can benefit greatly from progressively increasing their repertoire of coping strategies; however, in more advanced stages of a disease, patients may be too mentally exhausted to learn new strategies (Booth et al., 2011). Clinicians must be careful not to overstate the potential effects of an intervention, as this may set the patient up for feelings of failure and disappointment (Christenberry, 2005). Effective use of non-pharmacologic techniques with a patient may resemble an N-of-one trial, requiring problem solving, communication, compassion, and respect (Mularski et al., 2013; O'Driscoll et al., 1999; Taylor, 2007).

Clinical Research on Music Listening to Support Dyspnea Coping Strategies

Preliminary research has shown some evidence that intentional music listening can enhance coping strategies for patients with dyspnea. Many people instinctively used music listening in their own self-care to enhance exercise, relaxation, and quality of life (Metzger, 2004). Some occupational therapists, physical therapists, and nurses incorporate music into interventions for patients with dyspnea (Craig, 2008; Dahlin, 2006). Most of the current research focuses on using music to facilitate distraction, controlled breathing, and relaxation.

Distraction from respiratory sensations. Distraction is a coping strategy in which patients focus attention toward external stimuli and away from respiratory sensations. Distraction diminishes the affective dimension of dyspnea, helping patients to exercise more intensely with less anxiety. Over time, this helps counteract deconditioning, allowing patients to stay as active as possible. In a study of 24 patients in pulmonary rehabilitation for COPD, participants who were instructed to listen to music of their choice while walking reported a significant decrease in perceived dyspnea during activities of daily living, and showed significant increase in six minute walking test distance over time, compared to participants who were not instructed to listen to music during their walking program (Bauldoff, Hoffman, Zullo, & Sciurba, 2002). A study of 30 pulmonary rehabilitation patients with COPD showed that participants who listened to their selection of music during upper extremity training significantly improved their functional performance compared to those who did not listen to music during their training (Bauldoff, Rittinger, Nelson, Doehrel, & Diaz, 2005). In a study of 20 patients with COPD in pulmonary rehabilitation, participants who listened to their choice of music during a six minute walking test, compared to participants who did not listen to music, reported significantly higher positive affectivity and significantly lower global exercise-induced dyspnea and perceived dyspnea unpleasantness (von Leupoldt, Taube, Schubert-Heukeshoven, Magnussen, & Dahme, 2007).

Rhythmic auditory cues for controlled breathing. Occupational therapists help patients with dyspnea learn controlled breathing techniques, including pursed-lips breathing, diaphragmatic breathing, and others. With these coping strategies, patients use voluntary breathing patterns to optimize respiratory efficiency, improve respiratory muscle activity, counteract hyperinflation, and promote relaxation (Migliore, 2004). Qualified professionals must teach these techniques due to their potential contraindications (Booth et al., 2011; Clair & Memmott, 2008; Gosselink, 2003). Several of these controlled breathing techniques promote respiratory rhythm changes, particularly slower respiratory rate and longer expiratory time relative to inspiratory time. Lengthening the exhale helps to increase the volume of the breath, offset hyperventilation, and activate the parasympathetic nervous system to counteract the stress response (Booth et al., 2011; de Peuter et al., 2004; Gosselink, 2003; Janssens et al., 2000).

Auditory cueing may help patients learn and practice controlled breathing techniques. Occupational therapists sometimes use rhythmic auditory cues such as recorded human breath sounds to facilitate practice of optimal breathing rhythms (Migliore, 2004; Norweg et al., 2008). Some patients have shown improvements in dyspnea and blood pressure after treatment with a device called RESPeRATE, which monitors respiration and provides auditory cues for inhalation and exhalation (Ekman, Kjellström, Falk, Norman, & Swedberg, 2011).

Music therapists use live music with rhythmic entrainment to support beneficial respiratory rhythms for anxious or dyspneic patients. In a pilot study by Chen (2004), a board-certified music therapist collaborated with physical therapists to design a protocol using live musical cues to support pursed-lip-breathing and gradual decreases in respiratory rate for four patients with severe COPD, in addition to rhythmic auditory stimulation for walking. These patients improved their walking distance from 1-2 steps to 80-120 meters without needing supplemental oxygen or additional recovery time, and regained their ability to participate in valued activities.

Relaxation techniques. According to Herbert Benson, one of the first Western physicians to advocate for relaxation to promote health, the four elements required to elicit relaxation are a quiet environment, a comfortable position, a mental device to help break habitual thought patterns, and a passive and nonjudgmental attitude (2000). Relaxation strategies help patients learn to manage the affective dimension of their dyspnea, disrupt the dyspnea-anxiety cycle, and cope with insomnia, stress, depression, and other effects of chronic illness (Louie, 2004; Morgan & White, 2012). Guided relaxation techniques typically taught in pulmonary rehabilitation and self-management programs include imagery, progressive muscle relaxation (PMR), and passive progressive relaxation, also known as body scan (Miller & Hopkinson, 2008).

Individual differences can affect the outcome of relaxation techniques. For example, techniques that involve focusing on body sensations, such as PMR, may actually increase stress in individuals who tend to perseverate on somatic symptoms (Ziv, Rotem, Arnon, & Haimov, 2008). Guided imagery requires strong reality orientation and may be contraindicated for some patients (Louie, 2004). Some individuals experience relaxation-induced anxiety; distraction techniques may be more appropriate for these patients (Benson, 2000). Because relaxation strategies are most effective when practiced over time, they require motivation and adherence (Bausewein et al., 2008; Robb, 2000).

Despite these challenges, several studies have shown that music-supported relaxation techniques can have meaningful therapeutic outcomes for people with dyspnea. Louie (2004) showed significant increases in oxygen saturation for COPD patients participating in six guided imagery sessions with music compared with a control group. Singh et al. (2009) compared 72 COPD patients over two sessions of PMR or listening to self-selected relaxing music, and found significant reductions in dyspnea, systolic blood pressure, respiratory rate, heart rate, and STAI scores in both groups, with greater effects in the music group. In a study of healthy subjects, Robb (2000) compared the effects of music listening, PMR, combined music and PMR, and a silence control group, and found significant anxiety reduction in all treatment groups, with the greatest change in the combined PMR and music group. Mandel et al. (2010) piloted a music-assisted relaxation and imagery recording for 14 home-based cardiac rehabilitation patients and measured decreased levels of systolic blood pressure, anxiety, and stress levels post-treatment.

Caregivers can also benefit from guided relaxation and music. In a clinical trial of 32 family caregivers of hospice patients, where caregivers participated in music, PMR, combined music and PMR, or a control group, all three relaxation groups showed a significant improvement from pretest to posttest in anxiety, fatigue, and quality of life scores, with the largest effect in the combined music and PMR group (Choi, 2010).

Listening to relaxing music by itself, without verbal cues, can be an effective way to reduce anxiety. It can be especially helpful for patients who are too compromised to follow guided relaxation techniques. A meta-analysis if 14 clinical trials combining data from 805 mechanically ventilated patients showed that music listening had a large and clinically significant effect on anxiety reduction, and consistent effects on reducing respiratory rate, systolic blood pressure, and sedative and analgesic intake (Bradt & Dileo, 2014).

Therapeutic Benefits of Music Listening

Humans have used music as a healing agent for thousands of years, and in recent years, music has been increasingly reintegrated into certain areas of modern healthcare (Dobek et al., 2014). Advances in brain imaging technologies have allowed researchers to discover profound effects of music on many pathways in the brain. Although these processes are not yet completely understood, they provide useful information for designing and evaluating treatment interventions (Bernatzky et al., 2011; Chanda & Levitin, 2013; Dobek et al., 2014; Fancourt et al., 2014).

As a treatment modality, music can engage individuals on many different levels, from cellular to spiritual, from the rhythmic entrainment of neurons to connection with existential meaning (Clair & Memmott, 2008). Live music and active participation in music, such as singing and instrument playing, have abundant potential to improve outcomes for people with dyspnea (Panigrahi, 2014). While these possibilities are important, they are beyond the scope of this study; the present discussion will focus on the neurophysiological and practical benefits of passive listening to recorded music.

Neurophysiological Benefits.

Dopaminergic system: attention, motivation, and reward. Most people experience their preferred music as intrinsically motivating. Listening to pleasurable music stimulates activity in the ventral tegmental area and nucleus accumbens, areas of the midbrain that release dopamine. As the brain's "reward circuit," this system drives goal-directed processes such as attention, arousal, and motivation (Chanda & Levitin, 2013). By activating the brain's reward circuitry, music can enhance motivation to practice coping strategies, facilitate learning new skills, and support integration of new behaviors into current response schemes (Thaut, 2002).

Sensory processing: attention and distraction. The attention-drawing effects of pleasurable music also help to reduce perception of unpleasant stimuli. While music is engaging attention and flooding sensory channels in the brain, ascending signals from chemoreceptors, mechanoreceptors, and vagal afferents involved in respiratory sensation must compete for sensory processing resources. Fewer respiratory signals are processed, and the patient's perception of dyspnea is reduced (Krout, 2007; Norweg & Collins, 2013). This can help patients become less sensitive to their dyspnea, tolerate higher levels of activity, and direct attention away from anxious thoughts and feelings (Norweg & Collins, 2013). As a support for practicing relaxation techniques, music can help maintain the patient's attention over time, disrupting habitual thought patterns long enough to facilitate relaxation (Benson, 2000; Krout, 2007).

Parasympathetic nervous system. Neuroimaging studies have found that listening to pleasurable music reduces blood flow in the amygdala, insula, and anterior cingulate cortex, areas of the limbic system involved in the affective pathway of dyspnea processing (Chanda & Levitin, 2013; Dobek et al., 2014; Fancourt et al., 2014; von Leupoldt & Dahme, 2005; von Leupoldt et al., 2008). By modulating limbic system activity, music may help patients to experience less distress associated with dyspnea. Music's calming effects on the limbic system help to stimulate the parasympathetic nervous system, which signals to the body that a threatening situation has passed and the stress response is no longer needed. Music listening elicits chemical changes associated with the parasympathetic response, including decreased cortisol, increased oxytocin, and increased endogenous opioid levels in the bloodstream (Bernatzky et al., 2011; Fancourt et al., 2014; Krout, 2007). Relaxing music can elicit decreases in blood pressure, heart rate, respiratory rate, and muscle tension, indicating the body's shift from "fight or flight" to "rest and digest" mode (Fancourt et al., 2014; Singh et al., 2009). Relaxation of skeletal muscles helps to reduce the need for extra oxygen, reinforces the parasympathetic feedback loop, and may help reduce airway inflammation by influencing smooth muscles (Clair & Memmott, 2008; Krout, 2007).

Endogenous opioid system. Pain studies have shown that listening to pleasurable music stimulates the release of endogenous opioids, such as β-endorphins, which bind to opioid receptors and cause natural analgesic effects, reducing the need for pain medications such as exogenous opioids (Chanda & Levitin, 2013; Dobek et al., 2014). Dyspnea, like pain, is treated primarily with opioids in palliative care, and endogenous opioids may also help to relieve dyspnea. Using naxolone to block opioid receptors in a group of COPD patients, Mahler et al. (2009) found that the endogenous opioids released during exercise played a significant role in reducing the patients' dyspnea. While it has not yet been studied, it is possible that the endogenous opioids released by pleasurable music may similarly reduce dyspnea for breathless patients.

Rhythmic entrainment. While the neurologic effects of auditory stimuli on respiratory rhythm have not yet been studied, brain-imaging research has shown that the auditory system is connected with areas of the brain involved in both involuntary and voluntary breathing rhythm generation. Functional magnetic resonance imaging research has shown that the firing of brainstem neurons tends to resonate with auditory rhythms (Chanda & Levitin, 2013). In the cortex, auditory stimulation primes the motor system for movement by influencing motor planning and execution, and motor neurons can entrain with the rhythmic firing of auditory neurons (Thaut, 2013). Though respiratory rhythm generation is highly complex and not yet well understood, these entrainment effects suggest that music's rhythms may have the potential to influence both voluntary and involuntary breathing rhythm.

Memory and association. In a meta-analysis of music assisted relaxation techniques, Pelletier (2004) found that participants elicited greater relaxation responses after repeated practice with the same piece of music. By activating pathways in the hippocampus, para-hippocampal and frontal cortex regions involved in emotion and long-term memory, music can elicit associative memories of previously relaxed or positive emotional states (Altenmüller et al., 2014; Krout, 2007). Primitive pathways in the brain may also associate certain musical elements with stimuli that indicate safety and survival;

for example, relaxing music tends to resemble comforting natural sounds such as maternal vocalization and cooing (Chanda & Levitin, 2013).

Practical Benefits.

Caregivers. Many of the therapeutic benefits of music listening can also apply to caregivers. Caregivers may use music-assisted relaxation techniques to cope with their own stress (Choi, 2010; Malik et al., 2013). Music may enhance attention and motivation for caregivers who are learning to assist and reinforce patients' coping strategies (Clair & Memmott, 2008; Porter et al., 2011). Additionally, music listening can provide a shared positive experience between patients and caregivers, and elicit the release of oxytocin, which plays a role in social bonding (Bernatzky et al., 2011; Choi, 2010).

Pragmatics. Interventions using recorded music are safe, cost-effective, adaptable, simple to implement, and easily integrated into other treatment modalities, including emerging areas of internet- and smartphone-based interventions for dyspnea coping strategies (Norweg & Collins, 2013). Music provides many opportunities to integrate patient choice and preference into treatment. Because many individuals naturally use music in their coping, music interventions can empower patients to reinforce and expand their repertoire of coping strategies (Bradt & Dileo, 2014; Metzger, 2004).

Considerations for Music Selection

Music selection is a considerable challenge when recorded music is used for therapeutic purposes. For music to stimulate reward and relaxation pathways in the brain, the individual must subjectively find the music pleasurable and relaxing (Elliott, Polman, & McGregor, 2011; Krout, 2007). Individuals listening to music they dislike tend to show amplified activity in the amygdalae and temporal poles and increased stress and anxiety levels (Clair & Memmott, 2008). Age, preferences, cultural and social factors, and previous experiences may factor into responses to music. Some temperament aspects, such as introversion or extraversion, harm-avoidance and novelty-seeking traits, can influence the physiological effects of music (Chanda & Levitin, 2013). Affective responses to particular pieces of music vary greatly among individual listeners, and also among different moods and energy states for each individual (Tan, Yowler, Super, & Fratianne, 2012). While there is no standard procedure for music selection, music therapy researchers have surveyed and interviewed listeners to provide some guidelines for selecting music for relaxation (Davis & Thaut, 1989; Elliott et al., 2011; Krout, 2007; Tan et al., 2012; Wolfe, O'Connell, & Waldon, 2002). These guidelines are organized below into areas of simplicity and complexity; familiarity and novelty; tempo and rhythmic cues; harmony, melody, timbre, and pitch; and music elements that detract from relaxation.

Simplicity and complexity. According to appraisal theories of art and emotion, emotional responses to art, including music, depend on a novelty check (i.e., evaluation of the stimulus as new or complex) and a coping-potential check (i.e., evaluation of one's own ability to understand or cope with the stimulus) (Silvia, 2005). These are influenced by individual factors such as temperament, emotional state, and past experiences with music. People are most likely to pay attention to and appreciate music that passes both their novelty check and coping-potential check (Silvia, 2005). Survey results suggest music that most people find relaxing tends to be relatively simple, with predictable structure, rhythms, harmonies, and melodies; however, music that is too simple or repetitive may be perceived as “boring” or fail to hold the listener’s attention. Like most responses to music, preferences for musical simplicity vary among individuals and for the same individual in different conditions (Elliott et al., 2011; Tan et al., 2012).

Familiarity and novelty. The effects of familiarity on relaxation response to music vary among individuals. Some people relax best to their familiar music, regardless of tempo or other musical elements, especially if this music has been comforting to them in the past. For others, listening to their preferred music is pleasantly exciting but does not help them to relax (Davis & Thaut, 1989). Listeners may relate certain music with movie soundtracks, commercials, funerals, or other associations that detract from relaxation; these extra-musical associations are often personal and unpredictable (Elliott et al., 2011). Repeated practice with a particular piece of music may make it more effective in supporting relaxation or other coping techniques; however, the piece may become “stale” and no longer engage the listener’s attention after too much exposure (Tan et al., 2012).

Tempo and rhythmic cues. Most people prefer to relax to music with a tempo of 60-90 beats per minute, resembling a resting heart rate (Elliott et al., 2011; Tan et al., 2012). Some listeners who are anxious or depressed respond best to music that matches their mood and energy level and gradually modulates to a more desired state (Krout, 2007; Wolfe et al., 2002). Any auditory cues for breathing must match the respiratory rate and metabolic needs of the patient; if a breathing pattern feels imposed, it may affect corollary discharge and aggravate respiratory effort (Janssens et al., 2000; Norweg et al., 2008).

Harmony, melody, timbre, and pitch. Relaxing music typically has pleasant harmonies and legato melodies that are "easy to hum," with narrow intervals, moderate pitch range, and predominantly ascending contours (Elliott et al., 2011; Tan et al., 2012). Low bass sounds are often perceived as calming and grounding. Listeners tend to find acoustic instruments with soft timbres relaxing (Wolfe et al., 2002).

Music elements that detract from relaxation. Dramatic changes in dynamics, tempos, melodies, and harmonies tend to disrupt relaxation (Elliott et al., 2011). Music that is perceived as "sad" or "depressing" tends to be less effective for relaxation than music with a more neutral or pleasant emotional tone. High-pitched sounds, dissonant harmonies, accents and harsh articulation tend to startle and detract from relaxation (Wolfe et al., 2002). Certain elements are soothing to some listeners and distracting or aggravating to others, such as synthesizers, nature sounds, human voices, and lyrics (Elliott et al., 2011; Tan et al., 2012).

Music Therapists in Interdisciplinary Collaboration

Given the complexity of both dyspnea as a symptom and music as a treatment modality, music therapists and pulmonary rehabilitation clinicians can learn from each other. Occupational therapists, physical therapists, and nurses often use music to enhance coping strategies for patients with dyspnea, but there is little information in their training or literature on the therapeutic uses of music (Craig, 2008; Dahlin, 2006). Likewise, music therapists often help treat breathless patients in palliative settings, but there currently is minimal information in music therapy literature and education specific to dyspnea.

Music therapy, involving direct treatment by a board-certified music therapist, may be very beneficial for dyspneic patients and their families. Music therapists can also consult with other disciplines to help them use recorded music more skillfully as a therapeutic tool. In addition, music therapists can participate in research to help develop treatment strategies and identify best practices for applying music in dyspnea treatment. As clinicians, consultants, and researchers, music therapists can collaborate with other disciplines to identify and optimize strategies using music to enhance the effectiveness of dyspnea interventions (Bradt & Dileo, 2014).

The current work is a feasibility study of an individualized audio practice tool for home care patients receiving occupational therapy for dyspnea management. Co-designed by occupational therapists (OTs) and a board-certified music therapist, the intervention tool is a compact disc (CD) containing guided self-management strategies tailored to each patient’s needs, including relaxation and breathing techniques. Participants received recordings of music-assisted guided self-management strategies or self-management strategies without music, assigned to groups by study identification number (even numbers assigned to music group, odd numbers assigned to non-music group). The OTs encouraged patients to practice daily with the CDs as part of their treatment plan. Data included a Subjective Units of Distress Scale and Modified Borg Dyspnea Scales for Intensity and Unpleasantness before and after each practice session, and a 6-Point Chronic Disease Self-Efficacy Scale at the beginning and end of the study period. The original research question was: Can audio recorded coping strategies with therapeutic music reduce subjective severity of dyspnea, unpleasantness of dyspnea, and anxiety for patients in home care occupational therapy for dyspnea?

Method

Study Design

The study was designed to gather preliminary information on logistics and potential effectiveness of a novel treatment approach using recorded music-assisted coping strategies for home care patients with dyspnea. As expected, the researchers encountered many obstacles with the timing and delivery of treatment, leading to the recommendations in the Results and Discussion sections of this document. The original design included assigning patients to two groups: a treatment group who would receive recordings of music-assisted coping strategies, and a control group who would receive recordings of coping strategies without music. However, due to the timing and sample size limitations, the researchers were only able to gather pre-treatment and post-treatment data from one participant.

Researcher and Clinicians

The researcher is a board-certified music therapist with the hospice department of a non-profit home health and hospice organization. The researcher is credentialed by the Certification Board for Music Therapists and has been practicing music therapy professionally in medical and hospice settings for four years. The researcher's clinical training and experience has regularly included treatment of patients with dyspnea and anxiety.

The occupational therapists (OTs) collaborating in the study are a team of six clinicians with the home care department of the same home health and hospice organization. The OTs and occupational therapy assistants (OTAs) treat home care patients with a variety of conditions, including patients who experience dyspnea due to chronic obstructive pulmonary disease, congestive heart failure, and other diseases. Among other interventions, OTs guide and teach self-management strategies, such as relaxation and controlled breathing techniques. The OTs collaborated in designing the procedures of this study and recording the guided self-management strategies used in the intervention.

Participants

Participants included adult patients receiving home care occupational therapy any dyspnea-related diagnosis, selected by the OTs during their initial visit. Qualifying participants were those whom the OTs would teach breathing and/or relaxation techniques as dyspnea self-management interventions based on their clinical assessment. Inclusion criteria included the ability to hear recorded cues, read 12-point font, operate a CD player, comprehend verbal and written instructions in English, and give informed consent. Exclusion criteria included the inability to hear recorded cues, read 12-point font, operate a CD player, comprehend verbal and written instructions in English, or give informed consent, as well as any other cognitive, psychological, sensory, or physical factors that would prevent the study intervention from being appropriate for the patient's treatment plan. The local Institutional Review Board and Human Subjects Committee approved the study protocol, Informed Consent Form, and Health Insurance Portability and Accountability Act (HIPAA) Authorization for Research Form before participants were recruited.

Materials

Apparatus. The verbal cues were recorded using either an iPhone or a MacBook Pro laptop computer with a Blue Snowball USB microphone. The ensemble music tracks were recorded in a studio, and the solo music tracks were recorded using a MacBook Pro and Blue Snowball microphone. The audio tracks were edited and layered on a MacBook Pro using GarageBand digital audio workstation software. The individualized tracks were burned onto Memorex blank CD-R discs using iTunes media manager on a MacBook Pro.

Participants who did not own usable headphones were given on-ear or over-ear design headphones to use during the study period, with several options to provide a comfortable fit over individuals' hearing aids, nasal cannula, or other devices. The headphone options included DGL VS-750-BLK Vibe stereo headphones, Kensington K33137 hi-fi headphones, Koss UR-10 closed-ear design stereo headphones, and Panasonic RP-HT21 lightweight headphones. Participants who did not have CD players were given a portable CD player with batteries for the course of the study. The CD players varied in design, and were collected from donors and second-hand stores, tested for quality and functionality, and disinfected following home care infection control procedures.

Guided Self-Management Techniques. The OTs recorded verbal cues for seven guided relaxation and breathing techniques, described below.

Muscle Relaxation. The listener is guided through a series of exercises, including neck rolls, shoulder shrugs, arm stretches, knee raises, and foot and ankle rolls. The OT gives cues to take deep breaths between and during exercises, and explains that the exercises are intended to reduce stiffness and tension and allow the chest cavity to expand for a fuller breath.

Relaxed Breathing. Listeners are instructed to choose a word they associate with relaxation, such as "calm," "relax," or "peaceful." The OT gives cues for listeners to inhale through the nose, and say their relaxing word as they exhale slowly, pausing before taking the next breath. Listeners are instructed to take normal breaths rather than deep breaths, and to repeat the sequence 10 to 15 times.

Deep Breathing. The OT explains the benefits of deep breathing for relaxing the body, and asks listeners to lie on their back. Listeners are instructed to inhale slowly through their nose, filling the lower part of their chest first, then the middle and top part of their chest. Listeners are cued to breathe in over eight to 10 seconds, hold their breath for one to two seconds, and slowly let the air out, slowing down if they feel dizzy. The OT suggests an image of resting on a gentle ocean and letting the breath rise and fall with the waves.

Abdominal and Pursed-Lips Breathing. The OT describes the basic physiology of breathing, and explains the benefits of abdominal and pursed-lips breathing for allowing more oxygen inhalation and calming brain waves. Listeners are instructed to relax the body, drop the shoulders, breathe in through the nose, and breathe out gently through the mouth, keeping the lips in a gentle pucker. The OT suggests an image of blowing on a candle to flicker the flame, but not hard enough to blow the candle out. Listeners encouraged to slow their breathing, with their exhale about twice as long as the inhale, at whatever pace they feel is helpful.

Progressive Relaxation. Listeners are instructed to lie on their back and close their eyes, then feel their feet, sense their weight, consciously relax them, and let them sink into the bed. These relaxation cues are repeated for the knees, upper legs and thighs, buttocks, abdomen and chest, hands, arms, shoulders, neck, and head. The OT asks listeners to pay particular attention to any tension in their jaw muscles and the muscles around the eyes and cheeks. Listeners are asked to mentally scan their body for any places that might still be tense, and consciously relax those places.

Peaceful Scene. Listeners are asked to imagine a scene that they find peaceful, calm, and restful, and given several examples to choose from if they are not able to think of a scene. The OT instructs the listeners to imagine as many details about the scene as possible, using all of their senses, and asks questions about the sights, sounds, smells, textures, tastes, and other elements of the scene. Listeners are instructed to disregard any stressful thoughts and bring their attention back to the peaceful scene.

Guided Imagery. Listeners are asked to lie on their back with their eyes closed and imagine themselves in a favorite peaceful place. The OT instructs the listeners to relax and enjoy the imagery, and to return to it anytime they need to.

Supportive therapeutic music. Seven music tracks were written or improvised by the researcher and recorded with a small group of musicians, using acoustic instruments except for one track using an electric piano. Each track is 9-10 minutes in length. The tracks were edited and stored in GarageBand. The researcher used original music for this study to reduce the influence of associations and to follow the guidelines for relaxing music suggested in music therapy literature.

Three of the music tracks were designed to support specific guided relaxation techniques. The music was designed following the principals of Patterned Sensory Enhancement, a Neurologic Music Therapy technique, although the treatment was not music therapy, as it was not delivered directly by a music therapist within a therapeutic relationship. Track 1 was an electric piano track tailored to enhance the Muscle Relaxation technique, using the rhythmic, melodic, harmonic, and dynamic patterns of the music to support the exercises. Track 2 had a flute melody with a tempo of 70 beats per minute (bpm) with a repeated pattern that ascended for 10 beats, rested at the top for two beats, descended for 10 beats, and rested at the bottom for four beats. This pattern was designed to support the slow inhalation, breath holding, exhalation, and resting pattern of the Relaxed Breathing technique. Track 3 was a track at 50 bpm with a repeating pattern of melodic lines, alternating between flute and piano, which ascended for one beat and descended for three beats. It was designed to support lengthened exhale guided in the Pursed-Lips Breathing technique.

Four of the music tracks were designed to generally promote relaxation and to be combined with any of the guided relaxation techniques based on participants' responses to the Music Preference Form. These tracks had predictable rhythms and harmonies, and simple legato melodies with moderate ranges and primarily ascending contours. Each track had a theme and variations structure, in which a 16-measure theme was repeated throughout with variations in instrumentation, register, and rhythm. This structure was intended to create a predictable pattern with some novelty to maintain attention. Each track used acoustic instruments with soft timbres and was grounded with a bass instrument. The tracks were written in different styles to allow for variation in preference. Track 4 was a neoclassical-style track at 60 bpm with piano, cello, and flute. Track 5 was a solo acoustic guitar track at 65 bpm. Track 6 was a folk-style track at 70 bpm with dulcimer, guitar, mandolin, and violin. Track 8 used piano, cello, and guitar, and began with march-like rhythms at 100 bpm and gradually slowed to more flowing rhythms at 75 bpm by the end of the track, designed for participants who may initially be too tense to relate to relaxing music.

Measurement Tools

Modified Borg Dyspnea Scale – Intensity (MBDS-I) and Modified Borg Dyspnea Scale – Unpleasantness (MBDS-U). A clinical evaluation of 400 participants found the modified Borg scale (MBS) to be a valid and reliable assessment tool for dyspnea, with significant correlations between changes in MBS and PFER pretreatment to posttreatment ($r = -.31$, $P < .05$) (Kendrick, K.R., Baxi, S.C., Smith, R.M., 2000). The Borg scales used for this study were based on the Modified Borg Dyspnea Scale from the website of the American Academy of Disability Evaluating Physicians. Though the validity and reliability of this adaptation has not been assessed, the scales used in this study followed recent recommendations of the ATS by measuring the intensity and unpleasantness of dyspnea separately (Mularski et al., 2013; Parshall et al., 2012).

The instructions for the MBDS-I read: "Use this scale to rate the difficulty of your breathing. It starts at number 0 where your breathing is not difficult at all and progresses to number 10 where your breathing difficulty is maximal. How severe is your breathing difficulty right now?" The instructions for the MBDS-U read: "Use this scale to rate the unpleasantness of your breathing. It starts at number 0 where your breathing is not unpleasant at all and progresses through to number 10 where your breathing unpleasantness is maximal. How severe is your breathing unpleasantness right now?" Both Borg scales included numbers from 0 to 10, qualified by descriptors (0 = "not at all," 0.5 = "very, very slight," 1 = "very slight," 2 = "slight," 3 = "moderate," 4 =

"somewhat severe," 5 = "severe," 7 = "very severe," 9 = "very, very severe (almost maximal," 10 = "maximal") (AADEP, 2015).

Subjective Units of Distress Scale (SUDS). The Subjective Units of Distress Scale has shown significant validity related to clinicians' Global Assessment of Functioning ratings ($r = -.439$, $p < .001$), Taylor A Scale ($r = 0.351$, $p < .05$), and neurotic index ($r = 0.366$, $p < .01$); its reliability has not been measured (Tanner, B.A., 2012).The version of the Subjective Units of Distress Scale used for this study was based on the SUDS form on the Australian Government Department of Veterans' Affairs (DVA) website, chosen for its brief descriptors. The instructions read: "Rate your current distress, fear, anxiety, or discomfort on a scale of 0-10." The numbers were qualified by descriptors (0 = "totally relaxed," 1 = "alert and awake, concentrating well," 2 = "minimal anxiety and distress," 3 = "mild anxiety/distress, no interference with performance," 5 = "moderate anxiety/distress, uncomfortable but can continue to perform," 7 = "quite anxious/distressed, interfering with performance," 8 = "very anxious/distressed, can't concentrate," 9 = "extremely anxious/distressed," 10 = "highest distress/fear/anxiety/discomfort you have ever felt"). (Australian Government DVA, 2012).

Self-Efficacy for Managing Chronic Disease 6-Item Scale (SECD6). The SECD6 was a 6-item questionnaire developed by the Stanford Patient Education Research Center, which was found to have a convergent construct validity to the German General Self-Efficacy Scale (Spearman rank correlation = 0.578, $P < 0.001$) and high internal consistency (Chronbach's alpha = 0.930) (Freund, T., Genseichen, J., Goetz, K., Szecsenyi, J., & Mahler, C., 2013). Participants selected a number between 1 ("not at all confident") and 10 ("totally confident") for each item. The items included:

1. How confident are you that you can keep the fatigue caused by your disease from interfering with the things you want to do?
2. How confident are you that you can keep the physical discomfort or pain of your disease from interfering with the things you want to do?
3. How confident are you that you can keep the emotional distress caused by your disease from interfering with the things you want to do?
4. How confident are you that you can keep any other symptoms or health problems you have from interfering with the things you want to do?
5. How confident are you that you can do the different tasks and activities needed to manage your health condition so as to reduce you need to see a doctor?
6. How confident are you that you can do things other than just taking medication to reduce how much you illness affects your everyday life?

   (Standford Patient Education Research Center, n.d.)

Music Preference Form. This form was intended to help the researcher tailor the music to the participants' preferences. It was loosely based on the Music Assessment Tool developed for mechanically ventilated patients, with permission from the authors, simplified due to the more limited music selections available in the current study (Chlan & Heiderscheit, 2009). Questions on the form included:

1. Do you like to listen to music? (Yes/No)

2. When do you like to listen to music? (Check all that apply: relaxation, stress reduction, pure enjoyment, with family and friends, with exercise, stress reduction, to pass time, for prayer, during meals, during work, other)
3. Please mark your preferences for the following music genres (like/neutral/dislike): (classical, jazz, folk, new age)
4. Please mark your preferences for the following music instruments (like/neutral/dislike): (piano, guitar, flute, cello, violin, mandolin)

Procedures

During the initial OT assessment, the OTs asked patients who met the selection criteria if they would like to participate in a study in which they would practice guided coping techniques with an individualized CD, with verbal cues alone or verbal cues combined with music, for 10-30 minutes each day during their treatment period, and evaluate the results using brief questionnaires. The OTs gave the Informed Consent Form and HIPAA Authorization for Research Form to interested patients and provided opportunities for patients to ask questions and to sign the forms if they chose. The OTs placed the signed forms in an envelope to be delivered to the Principal Investigator's mailbox during their next visit to the home and community services office. Individuals who sign the Informed Consent Form and HIPAA Form were given copies of both forms to keep.

Participants were asked to complete a SECD6 scale on a form marked with a random number. This number became the participant's identification number for the purpose of the study. Participants with an even identification number were given CDs with music-assisted techniques, and participants with an odd identification number were given CDs with verbal techniques only. Participants were asked to complete the Music Preference Form printed on the back of the SECD6. The OTs placed the SECD6 and Music Preference Form in the envelope with the Informed Consent Form and HIPAA Form to be placed in the Principal Investigator's mailbox.

The OT selected 1-3 guided self-management techniques for each participant to practice daily, based on the participant's individual treatment plan, and introduced these techniques to the participant. If the participant did not have usable headphones, the OT gave the participant a pair of headphones, selecting a design that was comfortable for the participant. If the participant did not have access to technology for listening to CDs, the OT gave the participant a portable CD player to use for the duration of the study. The OT demonstrated using the CD player and filling out a sample Daily Practice Form.

After the initial visit, the OT sent an in-basket message to the researcher within Epic Hyperspace, the password-secured electronic health record system used by the home health and hospice organization, within a password-secured virtual private network. The message included the participant's name, study identification number, selected guided techniques, and music genre and instrument preferences. The OT then placed the envelope with the SECD6 and Music Preference Form in the mail.

Clinicians in the home health and hospice organization, including music therapists and OTs, only access information for only patients on their caseload as needed to provide care under HIPAA regulations. For the purpose of this study, the researcher had permission from the Institutional Review Board to temporarily access a minimal version of each participant's health record within Epic Hyperspace in order to record the participant's age, gender, and diagnosis, and to write the address on the packet to be mailed to the participant. The researcher entered a “Visit Not Billable” note in the participant’s health record, communicating participation in the study and the self-management techniques to be included on the CD. The researcher then deleted the in-basket message and terminated her own access to the participant’s health record, identifying the participant from that time forward only by study identification number, age, gender, and primary diagnosis.

The packet mailed to each participant included an individualized CD, instructions, Daily Practice Forms, an envelope for completed forms, and a final SECD6 form marked with instructions to save for the final OT visit. Each CD included 1-3 tracks of guided self-management techniques indicated by the OT, and was 10-30 minutes in length. Participants with odd study ID numbers received CDs with verbal cues only, and participants with even study ID numbers received CDs including verbal cues combined with supportive therapeutic music. Participants were instructed to practice daily with the CDs in a safe, quiet, comfortable place, using headphones.

The Daily Practice Forms were double-sided legal size forms with one side labeled “pre-test” and the other side labeled “post-test.” The dates and study ID number were pre-marked on the forms. Participants were instructed to complete the pre-test side before they practice each day, and to complete the post-test side after they practice. Each side of the form included a MBDS-I, MBDS-U, and SUDS, which are each 1-checkmark scales that take less than a minute to complete altogether. Each side of the form also included a “comments” section where participants were asked to comment on their experience. The envelope included a smaller envelope where participants were instructed to place their completed Daily Practice Forms.

Participants were encouraged to check in with their occupational therapy clinician about their experience with the CDs, and discuss any problems or preferences. If warranted, the occupational therapy clinician was instructed to send a message to the researcher requesting a new CD with different music or different self-management techniques to fit the participant's needs; the researcher would then send a second CD following the procedure above.

Each participant's study period was planned to conclude during the final OT visit. Participants were instructed to fill out a post-treatment SECD6 scale during this visit, and the OTs would collect the assessment packet, including the envelope with completed Daily Practice Forms, and any borrowed audio equipment. Participants were able to keep their CDs, and were offered a second CD with or without music if they wished at the end of the study period. The OTs were instructed to place the final SECD6 scale in the envelope with the completed Daily Practice Forms, and deliver it to the Principal Investigator's mailbox during their next visit to the home and community services office. The Principal Investigator stored the paper forms in a secure file cabinet within the home and community services office. These forms were shredded when they were no longer needed for the study.

Analysis

The researcher planned to analyze pre- and post-treatment SECD6, MBDS-I, MBDS-U, and SUDS using Friedman Two-Way Analysis of Variance. Between- and within-group differences were to be evaluated. The researcher also planned to type any written participant comments from the Daily Practice forms and any verbal or written comments from occupational therapy clinicians, and share these comments in the results section as appropriate. However, since only three participants volunteered for the study and data was only submitted from one, the data from the measurement tools are presented below without statistical analysis.

Results

Participant Response

The study period was reduced from the planned duration of three months to 75 days due to changes within the healthcare organization. Over 75 days, the OTs recruited three participants for the pilot study. Participants included two females and one male, ages 62-74, with primary diagnoses of COPD and acute respiratory failure. Two participants received recordings of music-assisted techniques, and one received a recording of verbal cues only. Two of the participants terminated home care treatment suddenly due to changes of condition, and the OTs were unable to retrieve their data forms.

One participant, a 74-year-old male with COPD, returned six completed daily practice forms, which included pre-intervention and post-intervention data for the MBDS-I, MBDS-U, and SUDS. This participant received a CD including music-assisted progressive muscle relaxation, relaxed breathing, and deep breathing. The OT collected a pre-treatment SECD6 but no post-treatment SECD6. No comments were recorded from the participant. The SECD6 reflected moderate levels of self-efficacy prior to treatment, with responses ranging from 3 to 7 on a scale of 1 (“not at all confident”) to 10 (“totally confident”) (Table 1).

Table 1

Self-Efficacy for Managing Chronic Disease 6-Item Scale Pre-test

Question	Rating
1. How confident are you that you can keep the fatigue caused by your disease from interfering with the things you want to do?	5
2. How confident are you that you can keep the physical discomfort or pain of your disease from interfering with the things you want to do?	5
3. How confident are you that you can keep the emotional distress caused by your disease from interfering with the things you want to do?	3
4. How confident are you that you can keep any other symptoms or health problems you have from interfering with the things you want to do?	6
5. How confident are you that you can do the different tasks and activities needed to manage your health condition so as to reduce you need to see a doctor?	7
6. How confident are you that you can do things other than just taking medication to reduce how much you illness affects your everyday life?	6

Note: Ratings refer to participant's self-assessment pre-treatment.

Six daily practice forms were collected from the participant, including pre- and post-intervention self-assessments of dyspnea intensity, dyspnea unpleasantness, and subjective distress. The participant rated consistent decreases for all three dimensions from pre- to post-intervention. These results are shown below in Figures 1-3, with columns comparing pre- and post-intervention scores from each daily practice form. The Modified Borg Dyspnea Scale–Intensity showed an average decrease of 1.4 points for dyspnea intensity (Figure 1).

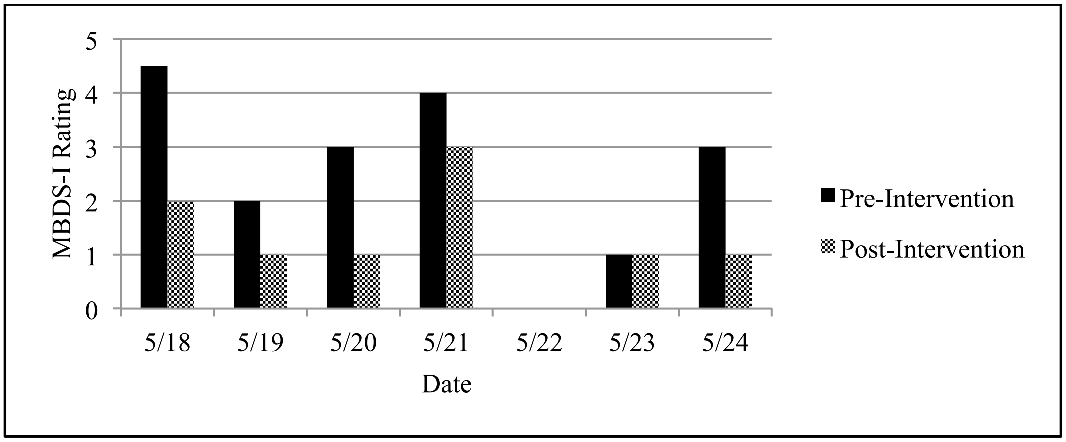

Figure 1. Modified Borg Dyspnea Scale–Intensity. Pre-intervention and post-intervention dyspnea intensity ratings self-reported by participant.

Similarly, the Modified Borg Dyspnea Scale–Unpleasantness showed an average decrease of 1.9 points for dyspnea unpleasantness (Figure 2).

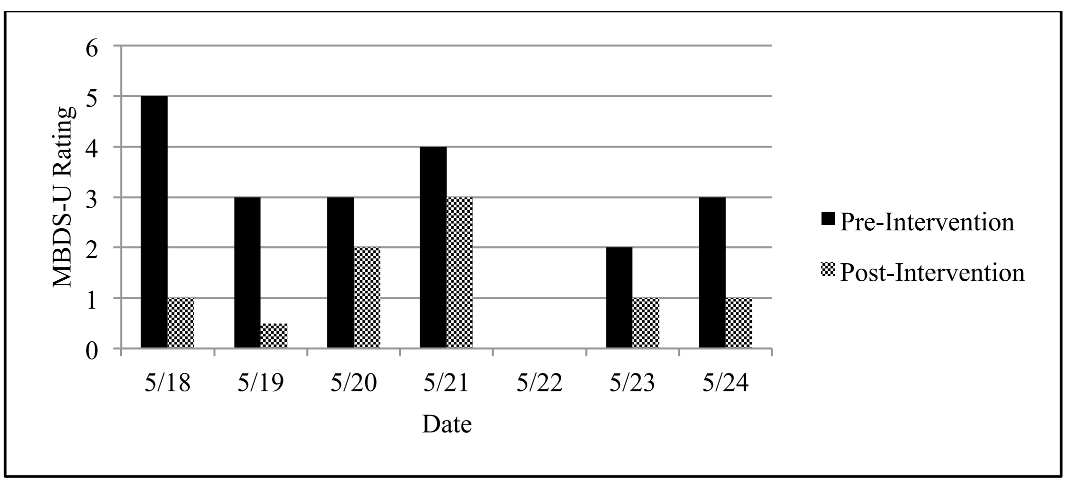

Figure 2. Modified Borg Dyspnea Scale–Unpleasantness. Pre-intervention and post-intervention dyspnea unpleasantness ratings self-reported by participant.

The Subjective Units of Distress Scale also showed consistent decreases from pre- to post-intervention, with an average difference of 3 points for anxiety (Figure 3).

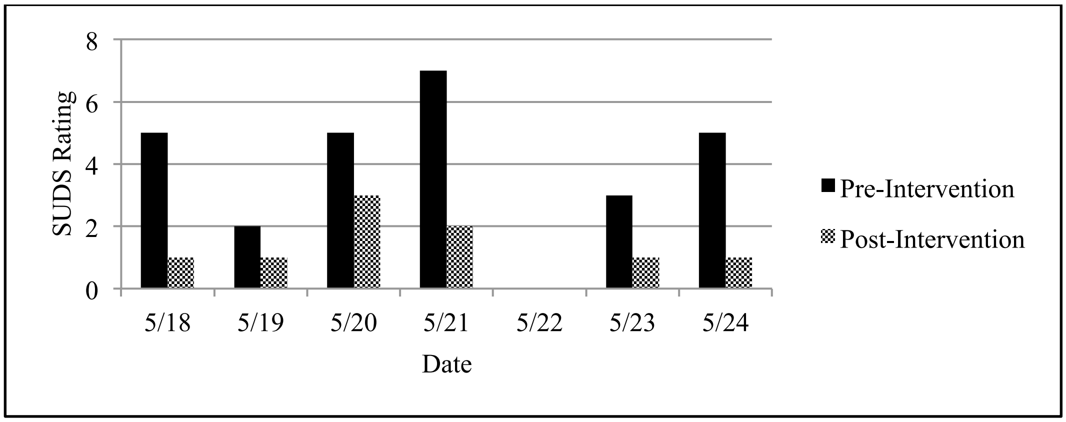

Figure 3. Subjective Units of Distress Scale. Pre-intervention and post-intervention distress ratings self-reported by participant.

The researcher did not run inferential statistics due to the small sample size.

Confounding Variables

Factors other than the intervention may have contributed to the decreases reported on the MBDS-I, MBDS-U, and SUDS. The act of taking time to rest in a comfortable position may have been beneficial in itself. The process of filling out the pre-intervention and post-intervention scales may have affected the results by increasing awareness of the connection between dyspnea and distress and the possibility of change in condition. Due to the small sample size, it is impossible to determine whether or not the music had an effect on the outcomes.

Assessment of Design

The study was designed to compare music-assisted coping techniques to a control group with non-music techniques to assess the effectiveness of music in enhancing outcomes. However, the sample size was too small to assess any effects of the music. In practice, the choice of music or non-music interventions may be best given to each individual; it would also be simple to provide selections of both music-assisted and non-music techniques on the same audio device. This intervention may be most effective if participants have as much choice as possible, and may be better compared to a control group who receives standard treatment.

Assessment of Procedures

The environment of home care posed several challenges to recruiting and maintaining participants. The number of patients enrolled in home care services who would qualify for the study was unpredictable. The OTs reported that some patients who were possible candidates were too overwhelmed to initiate the protocol. It is also common for home care patients to change condition unexpectedly. Home care clinicians are tightly regulated in their use of time and resources, and it is often impractical and unethical to make an extra trip to a patient's home to collect data. To perform a large study with this population would require a much longer study period to account for inevitable attrition.

The OTs reported that the study procedures were generally practical for them and for participants. They reported anecdotally that the participants who received music-assisted recordings enjoyed the music. Suggested improvements included offering a web-based option for the scales and flash drives in addition to CDs to accommodate participants' technology preferences. Another suggested improvement was to include a stamped and addressed envelope for participants to send back their own data, rather than relying on the OTs' scheduled visits, which are often unpredictable due to the nature of the work.

Assessment of Time and Resources

As predicted, the audio tool required minimal time and cost resources. Each track of music and verbal cues took 10-30 minutes to record, and once the recordings were made, each CD took less than 10 minutes to mix and burn. The blank CDs cost about $0.20 each, the headphones cost about $10 each, and the CD players cost under $5 each.

Discussion

Due to the small sample size, this study was unable to answer the original research question ("Can therapeutic music enhance the effectiveness of audio recorded guided coping strategies, compared to the same guided coping strategies without music, in reducing dyspnea severity, dyspnea unpleasantness, and anxiety, and improving disease-management self-efficacy for patients in home care occupational therapy for dyspnea?"). However, because the participant did report consistent decreases in dyspnea after using the intervention, because theory and previous clinical evidence supports the possible effectiveness of the intervention, and because the intervention is safe, practical, and time- and cost-efficient, future research is warranted. This project was useful as a feasibility study, and further feasibility studies may help to identify improvements for design of a larger study.

One improvement would be to increase the options for data collection. Collecting data from paper forms in a home care setting was a challenge in this study. For patients who are able to access the internet, web-based assessment forms may be more practical. For patients who require paper forms, it may be helpful to provide a stamped and addressed envelope as an option for returning forms.

Another revision would be to create simpler forms for participants. Although the ATS recommends that clinicians measure dyspnea severity and intensity separately, that separation may not be necessary for the purposes of this study, and it may be more practical to provide a simple Borg Dyspnea Scale and possibly eliminate the SUDS. It may also be more practical to ask participants to fill out practice forms a few times a week rather than every day, placing less demand on each individual. These changes may make the process easier for patients who are already likely to be physically and mentally exhausted.

It may be more practical for future studies to recruit participants from outpatient self-management programs rather than home care. While home care patients might benefit from the audio tool, they are more vulnerable and more likely to be too overwhelmed to participate in the study. Patients may gain more from the intervention if they are introduced to it earlier in their disease process, when they are able to take more active role in their disease management.

Study participation may improve if participants have an opportunity to meet briefly with the music therapist, who would be able to answer questions and tailor the audio tool more specifically to the patient. The participants' sense of personal connection and rapport with the researcher may play a role in adherence to the protocol. This condition would also allow the researcher to gather more qualitative information from participants about their experiences with the intervention, as well as their ideas for improvement.

Another development for this study would be to increase the amount of choice available to participants in designing their own audio tool. The review of literature highlights a broad range of individual differences in the experiences of dyspnea, effectiveness of self-management techniques, and physiological and psychological responses to music. For this intervention, comparing music to non-music conditions may be less useful than evaluating a treatment strategy that can be adapted to meet each individual's needs and preferences, and comparing the outcomes to standard treatment without the intervention.

One area of increased participant choice could be the expansion of technology options. Individuals vary greatly in their skills, access, and comfort level in using technology. Some participants may prefer to access audio files through a flash drive, email, or cloud computing. Advances in technology such as mobile apps have made it possible for patients or caregivers to record and mix their own audio coping strategy tracks if they have the resources and interest. Future research could provide more options to tailor the integration of technology to meet individual needs and preferences.

Another area of increased choice could involve music selection. For the purpose of this study, the researcher created music tailored to support the coping strategies based on available information. However, it may be more effective to provide an option of familiar patient-preferred music in addition to unfamiliar music created to support the techniques. While some individuals may prefer the researcher-designed music, other individuals may respond best to nature sounds or other ambient sounds, or music that is familiar to them. This may include music that they find personally or spiritually meaningful or music that they associate with a positive, relaxed state; both of these connections may help improve the effectiveness of the intervention. It would be simple to mix verbal cues into existing audio files using a digital audio workstation such as GarageBand. Patients may also be more likely to practice coping techniques if they have several options available. For example, an individual learning PMR may have a CD with a track of PMR verbal cues only, tracks of PMR verbal cues mixed with two different pieces of music, and tracks of the same music without verbal cues. This would provide the individual with choices each time they practice PMR.

A third area of increased choice could involve the recorded verbal cues. Because it is so simple to record these cues, they could be personalized for individual participants. Patients may decide to record their own verbal cues, or to have a loved one or trusted therapist record the cues and provide the added benefit of a familiar, comforting voice. Verbal cues could be personalized to a patient's individual respiratory patterns, preferred imagery, and phrases that the participant finds especially helpful.

Future research of this intervention may address caregiver benefits in addition to patient outcomes. The audio tool may help alleviate some of the helplessness that caregivers of dyspneic patients tend to feel by offering them ways to support the patient. Caregivers may choose to help with the design or implementation of the intervention, and may add the intervention to their repertoire of strategies for coping with dyspnea exacerbations. Caregivers may also benefit from an audio tool to practice relaxation techniques themselves in order to cope with the stress of caregiving.

The current literature on dyspnea and chronic disease shows a need for more research to identify best practices for non-pharmacologic interventions that can promote self-efficacy, support caregivers, address multiple dimensions of dyspnea, and help disrupt dyspnea-anxiety cycles, especially during exacerbations. There is a need for interventions that make efficient use of resources and can be adapted to individual needs and preferences. Clinical evidence from related populations, as well as current information on the neurophysiological effects of music, support the possibility of this intervention to improve outcomes for some dyspnea patients. There is no one-size-fits-all approach to dyspnea treatment, and patients, caregivers, and healthcare professionals can benefit from any information that increases their awareness and repertoire of treatment strategies. By identifying theoretical foundations for music-assisted dyspnea coping strategies, as well as practical improvements for future intervention and research design, this study may provide a small contribution to the search for best practices in dyspnea treatment strategies within a changing healthcare environment.

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