Discriminating Dyspnea Related to Lower Extremity and Whole Body Activity in COPD using the University of California San Diego Shortness of Breath Questionnaire

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By

Craig Luehrs

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The Ohio State University

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Approved by

Gerene S. Bauldoff, RN, PhD

Advisor

College of Nursing

Abstract

Purpose: To evaluate the ability of proposed University of California San Diego Shortness of Breath Questionnaire (SOBQ) subscores to discriminate changes in dyspnea related to Lower Extremity (LE) and Whole Body (WB) activity when compared to 6-Minute Walk (6MW) distance in persons with chronic obstructive pulmonary disease (COPD).

Subjects: Twenty-four patients (4 men and 20 women) with moderate-to-severe COPD (FEV1 41.3 ±13% predicted [mean ±SD]) aged 68.1 ±8 years.

Research Method: The SOBQ, providing only a total score, contains 24 items measuring perceptions of dyspnea for a variety of activities of daily living (ADLs). Three experts in pulmonary medicine and nursing classified each item into LE, upper extremity (UE), and WB activity subscores with the LE and WB subscores being the focus of this study. Using these proposed SOBQ subscores, a secondary analysis was performed using data obtained from an 8 week walking program. For the primary study, each subject completed both a SOBQ and 6MW at baseline, 4, and 8 weeks. The relationship between 6MW distance and proposed subscores at each time point was examined using Spearman's rho correlation.

Findings: Content validity was acquired for each proposed subscale with 100% concordance ratings among the pulmonary experts. SOBQ items 2, 3, 4, 5, and 7 compose the LE subscore and items 1, 10, 14, 15, 16, 18, 19, 20, 21 compose the WB subscore. At baseline, significant relationships were noted between 6MW distance and WB subscore ($r = -0.523$, $p < 0.01$) and total SOBQ score ($r = -0.453$, $p < 0.05$). At 4 and 8 weeks, only WB subscore significantly correlated with 6MW distance ($r = -0.508$, $p < 0.05$; $r = -0.422$, $p < 0.05$), respectively. A negative relationship existed between LE subscore and 6MW at each time point, although not significant.

Implications: The SOBQ does contain items specific to LE and WB activity. Furthermore, each of these proposed subscores negatively correlated with 6MW distance suggesting that the SOBQ has the ability to discriminate dyspnea related to LE and WB activity. This finding supports the use of the SOBQ as an effective measure of perceived dyspnea following LE specific exercise training in persons with COPD. Meanwhile, the weakening relationships of each proposed subscore with 6MW distance over time support the current design of the instrument with a single score.

Chapter I: Introduction

Introduction

Chronic obstructive pulmonary disease (COPD) is a progressive and irreversible lung disease marked by worsening symptoms of dyspnea during activities of daily living (ADLs). Both direct and indirect COPD-related health care costs totaled over 37.2 billion dollars in the year 2004 (American Lung Association [ALA], 2005). In the era of managed care and cost-cutting, interventions aimed at enabling these individuals to manage their symptoms independently are needed. The benefits of pulmonary rehabilitation programs (PRPs) for COPD patients have been well-documented in the literature (American Association of Cardiovascular & Pulmonary Rehabilitation [AACVPR], 1998). As part of a PRP regimen, a patient is gradually conditioned to sensations of dyspnea through repeated episodes of exercise training. Upon successful completion of a PRP, a COPD patient can expect to have an increased functional capacity to perform ADLs and an enhanced quality of life (QoL).

Unfortunately, gains in exercise tolerance diminish over time if exercise training is not maintained at an adequate intensity level (Vale, Reardon, and ZuWallack, 1993). A growing body of research supports the use of lower extremity (LE) specific exercise training to maintain improvements in activity tolerance in the wake of completing a formal PRP (Hernandez et al., 2000; Stulbarg et al., 20002; AACVPR, 1998). The University of California San Diego Shortness of Breath Questionnaire (SOBQ) is one outcome measure used for some of these studies. The SOBQ contains 24 items measuring perceptions of dyspnea for a variety of ADLs (Eakin et al., 1998). Moreover, the SOBQ provides only a total score with no discrimination between LE and whole body (WB) activities that may generate dyspnea. Considering that gains in exercise tolerance are limited to the muscle group trained (AACVPR, 1998), an evaluation of the SOBQ as an effective outcome measure following LE specific exercise is necessary.

Purpose

Identification of cost-effective strategies to promote exercise continuation beyond the rehabilitation setting in patients who are disabled with dyspnea, such as patients with moderate to severe COPD are desperately needed. Physical activity and fitness have been identified as focal areas for Healthy People 2010 (U.S. Department of Health and Human Services, 2000). The purpose of this pilot study is to evaluate the ability of the SOBQ to discriminate changes in dyspnea related to LE and WB activity performance in persons with COPD via proposed SOBQ subscores. In turn, the results of this study will provide necessary information related to the validity and reliability of the outcome measure of perceived dyspnea related to LE and WB specific activities as measured by the SOBQ.

Research Questions/Hypotheses

Q1: Does the SOBQ contain items that discriminate activity between LE and WB activities?

H.1.1: The SOBQ contains items specific to LE and WB activity.

Q2: What are the relationships between the SOBQ total score, LE subscore, and WB subscore, and the 6-Minute Walk (6MW) distance?

H.2.1.: A negative relationship will exist between the SOBQ total score and 6MW distance.

H.2.2.: A negative relationship will exist between the LE subscore and 6MW distance.

H.2.3.: A negative relationship will exist between the WB subscore and 6MW distance.

Q3: Does the SOBQ discriminate changes in dyspnea related to LE and WB activity when compared to 6MW distance?

H.3.1: The SOBQ will have the ability to discriminate changes in dyspnea related to LE and WB activity following its use as an outcome measure during LE exercise training.

Significance and Innovation

The SOBQ is only one of two dyspnea measures validated for this patient population and was an outcome measure used as part of the National Emphysema Treatment Trial (NETT) studies (National Emphysema Treatment Trial Research Group, 2003). The significance of the proposed study for advancing knowledge is to critically evaluate the SOBQ specific to LE and WB exercise and activity in persons with COPD. The innovation of the proposed study is the distinct evaluation of a widely used and well-described instrument to determine its ability to measure perceived dyspnea to LE or WB specific exercises and activities. Findings from this study will provide important information regarding the reliability and validity of the SOBQ to measure perceived dyspnea specific to muscle group exercise and activity.

The significance of the proposed study for nursing practice is to document the effectiveness of the SOBQ as a reliable and valid measure of perceived dyspnea specific to LE and WB activities. Nurse researchers can analyze their findings and be confident that the SOBQ can discriminate dyspnea related to a specific activity. In addition, the findings from this study warrant a further investigation of these proposed subscores as potential additions to the current design of the SOBQ. Following successful reliability and validity testing, these proposed subscores may enhance the instrument’s effectiveness following LE specific exercise training. Analyzing such instruments is one piece to the puzzle in improving knowledge of symptom management in patients with COPD in effort to maximize QoL and improve functional performance.

Chapter II: Review of Literature

Chronic Obstructive Pulmonary Disease (COPD)

The human lung consists of millions of tiny air sacs called alveoli with a collective volume of approximately 2500mL. A vast number of capillaries entwine these alveoli and it is here at the capillary-alveolar juncture where gas exchange occurs. Oxygen diffuses into the capillaries to assist with cellular functions while carbon dioxide diffuses into the alveoli to be expired from the body. A network of elastin fibers located within both the alveoli and bronchioles cause the lung to return to normal shape following inhalation; therefore, expiration is a passive process in a healthy client. When a particular agent such as cigarette smoke or environmental pollutant alters the structural integrity of these delicate alveoli and elastin fibers, exhalation becomes increasingly difficult and air is trapped in the distal portions of the lungs, thus initiating the slow and insidious progression of COPD (Connolly, 2004).

The underlying pathophysiology of COPD can involve hyper-inflated alveoli, constricted bronchiolar lumens narrowed by excessive mucous secretions, and/or edema resulting from chronic inflammation. With emphysema, the supporting structures of the lung are destroyed resulting in a permanent enlargement of the lung parenchyma. Chronic bronchitis manifests itself through a constant state of irritation leading to hyperplasia of mucous cells, mucosal edema, thick mucous secretions, and a chronic state of bronchospasm. Whether suffering from emphysema or chronic bronchitis, a patient cannot successfully exhale an adequate volume of air leading to a chronic state of lung distention. Consequently, hypoxemia develops from this impaired gas exchange, which limits a patient’s ability to perform ADLs independently and leads to a decrease in QoL (Connolly 2004).

According to the Center for Disease Control and Prevention (n.d.), COPD accounted for 119,000 deaths in the year 2000, making it the fourth leading cause of death in the United States. Moreover, of the estimated 24 million Americans victimized by COPD, 726,000 were hospitalized in that same year resulting from disease exacerbations (National Heart, Lung, and

Blood Institute [NHLBI], 2004). Furthermore, these extremely high figures of prevalence, morbidity, mortality undoubtedly place an enormous strain on today's health care system. Developing interventions helping patients to better cope with their disease is one way health care workers can attempt to alleviate the degree of physical and economic burdens attributable to COPD.

Dyspnea

The primary symptom of COPD is dyspnea, which can interfere with the ability to perform ADLs independently. Approximately 44% of persons with COPD report dyspnea while bathing and dressing, 32% report dyspnea while talking, and 28% report dyspnea while sitting or lying still (ALA, 2001). This perceived sense of breathlessness mandates a decrease in intensity and/or duration of the physical activity. Not surprising, a patient will often avoid those activities precipitating unbearable perceptions of dyspnea, thus propagating a downward spiral of deconditioning to the point where he/she has dyspnea at rest (Haas, Salazar-Schicchi, and Axen, 1993).

Several theories exist attempting to explain the underlying mechanisms producing dyspnea. Carter and colleagues (2003) suggest that the muscles of respiration must be used simultaneously for both breathing and facilitating arm movements and that this dual recruitment of respiratory muscles, occurring in a state of already worsened airflow obstruction, leads to marked breathlessness at sub-maximal activity levels (Carter, Holiday, Stocks, and Tiep, 2003). Mador and colleagues (2004) theorize that peripheral muscle weakness and atrophy are important causes of decreased exercise tolerance. This muscle wasting leads to decreased oxidative enzyme capacity within the muscle and a reduction in cellular bioenergetics, which requires the need for an increased respiratory drive (Mador, Bozkanat, Aggarwal, Shaffer, and Kufel, 2004). Finally, McConnell and Romer (2004) postulate that a patient perceives dyspnea because he/she is consciously aware of the increased central respiratory motor activity effort to drive respirations, yet an inadequate pulmonary response results in a conscious perception of shortness of breath. In other terms, individual knows the magnitude of respirations needed for a given level of exertion, but his/her damaged lungs are unable to compensate producing dyspnea. Improving a patient's threshold for the onset of dyspnea will surely diminish many of the negative physical and psychological symptoms of COPD by empowering the patient to increase functional capacity and promote independence for performing ADLs.

Pulmonary Rehabilitation

Participating in a comprehensive pulmonary rehabilitation program (PRP) is one way persons with COPD can cope with symptoms of dyspnea during activity. The American Association of Cardiovascular & Pulmonary Rehabilitation (AACVPR) (1998) reports its efficacy through decreased symptoms, improved QoL, increased exercise tolerance, independence in ADLs, and decreased utilization of medical resources. A PRP is specifically tailored to meet the needs of each individualized patient, often consisting of a balance between patient education and physical conditioning. Pertinent areas of patient education include techniques involving breathing retraining, methods of energy conservation, and disease management including correct use of medications and recognizing the early warning signs of respiratory infections. Physical conditioning focuses on strength and endurance training and the development of a home based exercise schedule to maintain gains in physical fitness obtained during the program. The educational component facilitates an understanding of the nature behind the disease process and discusses proactive measures that can slow progression of COPD. Meanwhile, the physical activity component promotes an increase in activity tolerance directly related to improved physical conditioning and desensitization to feelings of dyspnea. Taken collectively, the successful completion of a PRP promises the desired outcomes of increased independence in the community, decreased incidence of hospitalizations, and subsequent increased quality and longevity of the patient's life (AACVPR, 1998).

Effects of Exercise Training on Activity Tolerance

Lake and colleagues (1990) examined the effects of upper extremity (UE) training alone or in combination with lower extremity (LE) training on exercise performance and well-being in patients with COPD. Twenty-eight patients suffering from severe COPD with no history of formal exercise training were recruited for participation into one of four groups: upper limb training, lower limb training, combined training, and no intervention. The experimental design called for patients to undergo one hour sessions three times a week for 8 weeks with each session consisting of 10 minutes of warm-up, 30 minutes of training, and 10 minutes cool-down. The 30 minutes of training was contingent upon the subject's assigned group, with the upper limb group undergoing circuit training exercises and the lower limb group performing walking exercises. Results of the study revealed a significant improvement in patient self efficacy following the combined exercise treatment with a minor increase in reported self efficacy in patients completing lower limb training. Additionally, the six minute walk (6MW) improved significantly from baseline to post test following walking and combined training. These results demonstrated that exercise training can improve exercise tolerance in patients with severe COPD. While a significant improvement in walking distance and a slight increase in self efficacy following a walking program occurred, combination with UE training produces the most improvements in reported functional capacity. UE training alone yielded no significant improvements suggesting that the training effect is limited to the specific muscle group trained (Lake, Henderson, Briffa, Openshaw, and Musk, 1990).

Mador and colleagues (2004) sought to determine whether the addition of strength training to endurance training would promote increases in exercise performance and QoL while reducing perceptions of dyspnea during exercise. The thirteen subjects enrolled in the endurance group underwent supervised exercise sessions, consisting of cycle ergometry and treadmill walking starting gradually and progressing to a point of intolerable dyspnea, three times a week for 8 weeks. Meanwhile, the other eleven participants followed this protocol with the addition of four strength training exercises involving the hamstrings, quadriceps, pectoralis major, and latissimus dorsi muscle. Following completion of the 24 sessions of training, the strengths of each muscle trained was significantly increased for the combined group compared to the endurance group. However, both groups reported significant improvements in 6MW, endurance test, and QoL suggesting that strength training does not translate into additional improvements in these measures. As a result, endurance training alone is effective in promoting improvements in functional capacity and self efficacy without the undue strain of strength training (Mador, Bozkanat, Aggarwal, Shaffer, and Kufel, 2004).

Hernandez and colleagues (2000) conducted a study attempting to prove the effectiveness of simple home-based exercise training of the LE muscles as measured by the shuttle walking test (SWT). They randomly assigned 60 subjects into either an exercise group or a control group. Subjects in the experimental group performed one session six days a week for a total of 12 weeks in the home environment whereas control subjects were given no instructions for exercise training. Participants in the experimental group were to complete a SWT by increasing speed at one minute intervals to a point where they could no longer tolerate the intensity level due to feelings of extreme dyspnea. The speed for the walking program was set at two levels below the maximum speed achieved during a baseline SWT and each session lasted approximately one hour with resting time included. While there was an adherence issue with 10 patients dropping out of the rehabilitation group and 13 patients from the control group, study results revealed a significant increase in both time and distance walked during the sub-maximal SWT. Although there were no improvements for any of the maximal effort parameters, the improvement in sub-maximal exercise is more beneficial because ADLs involve resistance rather than force. Furthermore, basal dyspnea and QoL improved significantly upon completion of the walking program (Hernandez et al., 2000).

Stulbarg and colleagues (2002) evaluated whether the addition of supervised training sessions to a pre-established home exercise program would be successful in reducing symptoms of fatigue and improving physical function. Furthermore, they hypothesized that the number of supervised exercise sessions would have a direct correlation with a decrease in symptoms. Researchers randomized 103 patients into one of three groups. One group was instructed to walk for a minimum of 20 minutes for four sessions per week making sure to keep a daily log to record details of each session. The other two groups were to also follow these instructions with one group adding four nurse-coached treadmill exercise sessions lasting 30 minutes once every other week and the other group receiving 24 supervised sessions three times a week for a span of eight weeks. While results indicated an increase in 6MW across all groups, the group receiving 24 additional sessions of nurse-coached treadmill training produced significant increases in 6MW distance. However, all groups reported a decrease in dyspnea and an overall improved health related quality of life (Stulbarg et al., 2002).

Finally, the AACVPR (1998), who evaluated relevant literature related to the topic of exercise training in COPD, supports that exercise training in a supervised environment or home based setting can decrease symptoms of dyspnea, improve QoL, increase exercise capacity, and independent performance of ADLs. Furthermore, the Global Initiative for Chronic Obstructive Lung Disease (GOLD) published guidelines outlining a complete strategy for the diagnosis, management, and prevention of COPD. One main point of emphasis was establishing a regular exercise regimen to reverse the negative processes of social isolation, physical deconditioning, and depression by instilling a sense of independence and improved self efficacy in the individual (the Global Initiative for Chronic Obstructive Lung Disease [GOLD], 2004).

Although a majority of these studies reported increases in exercise performance following training, few attributed the training effects to increases in physiologic function. Because physiological parameters of heart rate and ventilation failed to change from baseline, Lake and colleagues (1990) postulate that improvements result from such factors as improved coordination, better motivation, and desensitization to dyspnea. Furthermore, addition of strength training to endurance training only offers the risk of tiring the patient and inhibiting performance of existing endurance training. Therefore, endurance training should be the focus of most exercise sessions (Mador et al., 2004). While notable gains are associated with such exercise programs, adherence issues often arise without supervision and thus negate the positive gains acquired during exercise training.

Maintaining results following a PRP

Numerous studies document the effects of improved exercise tolerance and enhanced QoL in COPD patients upon immediate completion of a comprehensive PRP. Unfortunately, maintaining these gains can be an issue for many patients for it is also well-documented that post-PRP gains begin to decline to a baseline value over time. Vale and colleagues (1993) evaluated the long-term nature of a six week outpatient pulmonary rehabilitation in 51 patients receiving written and verbal instruction for maintaining exercise at home. Significant declines in both exercise endurance and QoL were noted at 11 months after the PRP although these values were still higher than pre-PRP baseline values (Vale, Reardon, and ZuWallack, 1993). Similarly, another study by Griffiths and colleagues (2000) found a significant reduction in QoL and exercise endurance 12 months after completion of a six week PRP while these measures were still higher than pre-PRP measures (Griffiths et al., 2000). Finally, Inoue and colleagues (1998) evaluated the long term effects of a PRP for up to one year following completion of a PRP and, based on their findings of a gradual deterioration of exercise capacity, concluded that implementation of maintenance programs may be necessary to retain the benefits achieved during a PRP (Inoue et al., 1998).

University of California San Diego Shortness of Breath Questionnaire (SOBQ)

Exercise training of the LE has been shown to be effective for decreasing symptoms of dyspnea and increasing activity tolerance associated with everyday activities in patients with COPD (AACVPR, 1998). The SOBQ is an instrument used by researchers to evaluate the effectiveness of exercise training on symptoms of perceived dyspnea associated with 24 activities of various levels of exertion. The SOBQ has been tested to be a reliable and valid instrument and has been used in numerous past studies involving patients with COPD (Eakin et al., 1998).

Currently, the SOBQ consists of a list of activities that vary in the required level of exertion and involvement of each extremity. Studies determining the effectiveness of UE training or LE training in COPD patients have both used the SOBQ to measure changes in perceived dyspnea following intervention (Bauldoff, Hoffman, Zullo, and Sciurba, 2002; Bauldoff, Rittinger, Nelson, Doehrel, and Diaz, 2005). Administration of the SOBQ requires subjects to rank their perceptions of breathlessness on a scale from 0 (no breathlessness) to 5 (maximal breathlessness). Finally, the self-reported score for each item are summed and the magnitude of the final score denotes the subject's perception of dyspnea associated with a wide range of activities (The University of California San Diego Medical Center, 1995).

Eakin and colleagues (1998) conducted a study to validate the SOBQ as a reliable measure of perceived dyspnea during activity. They compared the current version of the SOBQ to previously validated dyspnea measures such as 6MWT, Borg Scale of Perceived Breathlessness, Quality of Well-Being Scale, and the Center for Epidemiologic Studies Depression Scale, and an old version of the SOBQ. Their findings revealed similar correlations with the other instruments in comparison to the old SOBQ and reported an excellent internal consistency revealing that each item on the questionnaire contributed to the reliability of the final score. Consequently, the SOBQ has been tested to be a valid instrument of perceived dyspnea during 24 ADLs in patients with moderate-to-severe COPD (Eakin et al., 1998).

Conclusion

Functional gains in exercise tolerance and perceived dyspnea are specific to the muscle group trained (Lake, Henderson, Briffa, Openshaw, and Musk, 1990). As a result, gains in activity tolerance following LE exercise training are limited to LE muscle groups whereas UE exercise training only improves UE activity tolerance. Interestingly, the SOBQ provides only a total score with no discrimination between LE, UE, or Whole Body (WB) activities that may generate different levels of dyspnea. This observation reinforces the need for an evaluation of the SOBQ, considering its use in studies evaluating both LE and UE exercise interventions. The use of proposed LE, UE, and WB subscores may enhance the effectiveness of the SOBQ in detecting changes in perceived dyspnea related to specific activity (LE, UE, or WB) following extremity-specific exercise training

Chapter III: Methods

Introduction

A secondary analysis was performed using SOBQ and 6MW data collected in the study "Exercise Maintenance Following Pulmonary Rehabilitation: Effect of Distractive Stimuli" (Bauldoff, Hoffman, Zullo, and Sciurba, 2001). This randomized-control study consisted of an 8 week unsupervised home walking program in persons with COPD who had completed a PRP within the last 12 months. This study tested the effects of distractive auditory stimuli (DAS) in the form of music as a strategy for promoting adherence to an exercise program following completion of a PRP to maintain improvements in perceived dyspnea. Subjects in the experimental group were instructed to listen to music while walking whereas those subjects in the control group did not listen to music while exercising. Experimental testing was performed at baseline, 4, and 8 weeks with subjects completing a SOBQ and two 6MW at each time point. For the current study, SOBQ items were classified into proposed subscores, which were then correlated with corresponding 6MW data.

Sample

The target population of the study includes those patients with COPD who have successfully completed a comprehensive PRP following AACVPR guidelines within the last 12 months. Subjects were selected for participation in the study if they met all inclusion criteria including 40 to 85 years of age, ability to hear without assistive devices, ability to read, write, and speak English, and time since completion of the PRP was less than 12 months prior to study entry. Exclusion criteria included the presence of unstable cardiac disease, musculoskeletal disability preventing exercise, inability to walk independently, and the presence of severe hearing loss (Bauldoff, Hoffman, Zullo, and Sciurba, 2002).

Subjects were selected by convenience sampling methods and recruited from four separate outpatient pulmonary rehabilitation sites located in Allegheny County in Pennsylvania. To obtain a power > 0.80 with an alpha level of 0.05, a sample size of 18 was needed, with six additional subjects being included to account for possible attrition. Therefore, the first 24 patients who met the inclusion criteria, consented to participate, and completed 8 weeks of data collection were included in the study (Bauldoff, Hoffman, Zullo, and Sciurba, 2002).

The researchers informed the rehabilitation nurses and staff about the study and asked for their help in recruiting potential subjects. Once a potential subject was identified, the researcher would contact them by telephone to set up an interview to meet with them at the outpatient PRP site. After introducing the study to the subject, researchers obtained informed consent and began background testing to determine eligibility for the study. Finally, 24 subjects were recruited and randomized into two groups by an individual not involved with the study (Bauldoff, 2001).

The results of convenience sampling threatened bias by recruiting a disproportionate amount of females (83%). In attempt to include more males, six men were approached but refused to consent because they did not wish to be randomized (Bauldoff, Hoffman, Zullo, and Sciurba, 2002). All other demographic variables of sample were representative of national averages, with the exception being an under representation of ethnic minority groups. Selecting subjects from four different sites created divergence among subjects and increased the likelihood that the sample would be representative of the population.

Procedure

For the primary study, 24 COPD patients were randomly assigned to either the experimental group (N=12) or the control group (N=12). All subjects were instructed to complete a walking program that encouraged a minimum duration of 20 minute per session with preference of 30 to 45 minutes per session. Subjects were instructed to walk for 2 to 5 days per week for a total span of 8 weeks. Subjects in the experimental group were to select a preference of music (country/western, classical, pop/Motown, big band) ranging from a tempo of 90 to 110 beats per minute. These subjects then listened to their music selection delivered via a portable audiocassette player during their walking sessions. For the walking surface, subjects were to choose a flat surface and encouraged to use the same site for each session. Finally, subjects were instructed to walk at a pace that coincided with a rating of 2 or 3 on the Modified Borg Scale. Subjects in the control group were given the same instructions as the experimental group with the exception of not listening to music while walking (Bauldoff, Hoffman, Zullo, and Sciurba, 2002).

Under the supervision of researchers, subjects completed two 6MW separated by a resting time of 30 minutes during baseline, 4, and 8 week data collection visits. Only the furthest 6MW distance out of the two was recorded, according to 6MW testing protocol. The 6MW, prompting individuals to walk as far as possible in 6 minutes, is a tool commonly used in both the clinical and research setting to measure LE functional capacity to perform the ADL of walking (Steele, 1996). Meanwhile, each subject completed a SOBQ during the 30-minute resting period at each time point (Bauldoff, Hoffman, Zullo, and Sciurba, 2002).

For this study, three experts in pulmonary medicine and nursing classified each SOBQ item as either a LE, UE, or WB activity. Because the intervention of the primary study involved LE exercise and the 6MW was used as the mode for comparisons, only the LE and WB subscores were the focus of this study. A secondary analysis was then performed of primary study SOBQ and 6MW data using the newly proposed LE and WB subscores. Following the recommendations of the three experts, the pre-existing SOBQ data set was rearranged to include LE and WB calculations in addition to the total score. Finally, all subject’s baseline 6MW distances were correlated with baseline SOBQ scores, a process that was then repeated using 4 and 8 week 6MW and SOBQ data.

Protection of Human Subjects

Because this was a secondary analysis, no physical contact was made with any subject, thereby imposing no risk for physical or emotional harm. The subjects who participated in the primary study were not subject to any detrimental effects to physical or emotional well-being. To ensure safety, subjects used their prescribed oxygen during the 6MW and a strict protocol was followed to be certain patients maintained an oxygen saturation ≥ 88%. To observe the principle of self-determination, all subjects voluntarily participated in the study, were allowed to ask questions, and could request clarification regarding procedure guidelines. Additionally, no forms of coercion were implemented to increase sample size and subjects were informed of their right to withdraw at any time. Prior to obtaining informed consent, full disclosure was provided to subjects by fully describing the nature of the study and the possible risks and benefits for participating. Finally, the study was reviewed and approved by the University of Pittsburgh Institutional Review Board (personal communication, G.S.B., April 25, 2005).

Confidentiality and privacy were maintained for this study by not releasing the name of any subject participating in the study. Additionally, the primary study did not require subjects to write their name on completed SOBQ and by storing informed consent forms in a separate filing cabinet, the researchers were not in contact with any personal information when examining the data. The three pulmonary experts were instructed to keep the questionnaires concealed in an envelope at all times and to refrain from discussing the data with anyone not associated with the study. Finally, all materials consisting of collected data were stored in a locked file cabinet in the office of G.S.B. at The Ohio State University College of Nursing, with access reserved to the researcher and faculty advisor.

Instrumentation

1). University of California San Diego Shortness of Breath Questionnaire (SOBQ)

The SOBQ is a 24 item self-report instrument measuring perceived dyspnea for a variety of ADLs. A patient is instructed to indicate/anticipate the severity of shortness of breath experienced for a particular ADL on a six-point scale ranging from 0 (“not at all) to 5 (“maximal or unable to do because of breathlessness”). The first 21 items assess dyspnea for a specific ADL, while the last 3 items assess the overall impact of dyspnea on daily life. Scores can range from 0 to 120, with higher scores indicating more severe perceived dyspnea. Reliability testing revealed both excellent internal consistency (Cronbach’s alpha=0.96) and adequate item-total correlations (0.49 to 0.87). In addition, the SOBQ was found to be a valid measure of perceived dyspnea for the COPD patient population. The SOBQ scores correlated negatively with physiologic measures of disease severity, health-related QoL, and exercise tolerance. Meanwhile, the SOBQ scores correlated positively with Borg Scale ratings, depressive symptoms, and lung capacity (Eakin et al., 1998).

2). Inter-Rater Reliability

Three experts in pulmonary medicine and nursing classified each item as either being a LE, UE, or WB activity, with 100% concordance ratings desired for each item. LE subscore activities are expected to include all items requiring a majority of LE use and minimal UE activity. UE activities are expected to include those items requiring a majority of UE activity and minimal LE activity. Finally, WB subscore items are expected to include all those items requiring near equal use of both the LE and UE. “Walking up a hill”, “Brushing teeth”, and “Watering Lawn” are SOBQ items that would be examples of LE, UE, and WB activity, respectively.

3). Six Minute Walk (6MW)

Functional performance of the LE, defined as an individual’s ability to perform everyday activities requiring the use of the LE (primarily walking), was measured using the 6MW. The 6MW is an effective measure to determine the efficacy of an intervention on independent free-walking (Bauldoff, 2001). While progressive, incremental tests using treadmill or cycle ergometry are considered the “gold standard” for measuring LE exercise capacity, the 6MW has been shown to correlate strongly with these conventional tests on measures of maximal minute ventilation and peak oxygen consumption. Furthermore, the 12-Minute Walk (12MW) was shown to correlate significantly with FEV_1 ($r=0.34$; $P<.05$) and FVC in liters ($r=0.46$; $P<.05$). Because the 12MW correlates strongly with the 6MW ($r=0.95$), the 6MW is preferred because it takes less time to administer, is better tolerated by patients, and allows multiple test repetitions to be carried out in one day. Finally, the 6MW has moderately correlated with other self-report questionnaires of dyspnea and physical function ($r=0.47$-0.59) (Steele, 1996).

Data Analysis

Concordance ratings for each SOBQ subscore would establish the level of content validity and subsequently determine if the SOBQ does indeed contain items specific to LE and WB activity. Next, data were entered into a SPSS version 13.0 data file and statistical analysis was performed. Although the SOBQ data were independent for each time point, the data were skewed to the right, thereby violating an important assumption of parametric testing. Consequently, Spearman’s rho non-parametric correlations were computed to examine the relationships between 6MW and SOBQ scores at baseline, 4, and 8 weeks. The strength and direction of each correlation between proposed subscore and 6MW was used to evaluate the ability of the SOBQ to discriminate dyspnea related to a specific activity.

Chapter IV: Results

The convenience sampling method produced a total of 24 subjects with moderate-to-severe COPD (FEV1 41.3 ± 13% predicted) aged 68.1 ± 8 years. Of these 24 subjects, 20 (83%) were female, 19 (83%) were Caucasian, and 5 (17%) were African American. Refer to Table 1 located in the Appendix section for other important demographic information.

Content validity for the three proposed subscores of the SOBQ was acquired with 100% concordance among three pulmonary experts in medicine and nursing in ranking the items within the instrument on one of three levels: a lower extremity (LE) activity, an upper extremity (UE) activity, or a whole body (WB) activity. Items 2, 3, 4, 5, and 7 together constitute the LE subscore. Items 6, 8, 9, 11, 12, 13, and 17 together constitute the UE subscore. Finally, items 1, 10, 14, 15, 16, 18, 19, 20, and 21 together constitute the WB subscore. Refer to Table 2 for specific item descriptions and their subscore category.

All subjects (N=24) completed each a 6MW and SOBQ at baseline, 4 weeks, and 8 weeks producing 24 data points (a pairing of a SOBQ score with its corresponding 6MW distance) at each time point. A significant relationship existed between the baseline 6MW and the WB subscore ($r = -0.523$, $p<0.01$) and the total score ($r = -0.453$, $p<0.05$). At four weeks, only a significant correlation was seen with the WB subscore ($r = -0.508$, $p<0.05$). Interestingly, the correlation between 4-week 6MW and total score ($r = -0.359$) was no longer significant. Again, at 8 weeks only the WB subscore and the 8 week 6MW distance was significantly correlated ($r = -0.422$, $p<0.05$). Although, not a significant correlation, the LE subscore was negatively correlated with 6MW distance at baseline and 4 weeks. Refer to Table 3 for each subscore's correlation with 6MW distance.

Chapter V: Discussion

The high content validity for each proposed subscore as evidenced by 100% concordance ratings suggests that the SOBQ contains items differentiating between LE, UE, and WB activity. The efforts of this study are similar to those of Linacre and colleagues (1994), who performed an in-depth analysis of the Functional Independence Measure (FIM), which is an 18-item instrument measuring a patient's degree of disability and burden of care. The FIM is intended to combine the 18 items to produce a single measurement of disability, but the researchers found that the measurement capability of the FIM was improved when the 13 motor items and 5 cognitive items were separated into two different groups (Linacre, Heinemann, Wright, Granger, and Hamilton, 1994).

The negative relationships existing between the 6MW distance and the various subscores support the assumption that a low SOBQ score (indicating low levels of dyspnea) should be accompanied by a high 6MW distance and visa versa. This is due to the expectation that the less dyspnea reported, a greater 6MW distance should ensue. This finding is consistent to that found in a study in which the correlation between the 6MW and SOBQ total score was -0.68 (Eakin and colleagues, 1998). The slight difference in strength of correlations between the two studies may be attributed to the large difference in sample sizes. Specifically, the negative correlations between the LE subscore and 6MW indicates that the SOBQ has the ability to discriminate changes in dyspnea associated with LE activity. However, the lack of a significant relationship at any time point between the 6MW and the LE subscore suggests that this grouping of items does not account for enough variance of the SOBQ total score to stand alone as an independent subscore. This finding may be attributed to the fact that only 5 of the SOBQ items are descriptive of activity that solely requires the use of the LEs. As a result, the limited number of LE activity items may explain why significant correlations with the 6MW were not obtained.

In addition, the negative correlations between the WB subscore and 6MW suggests that the SOBQ is capable of discriminating changes in dyspnea related to WB activity. In contrast to the LE subscore, the WB subscore was significant at all three time points. Moreover, the baseline relationship was significant at the level of $p<0.01$. These findings may reveal that this grouping of items may account for the largest amount of variance in the total SOBQ score and therefore may be better reflective of dyspnea of overall functional performance. Although WB was the only subscore significantly correlated at all three time points, it too was trending towards non-significance over time. This lack of evidence for any proposed subscore indirectly supports the current design of the SOBQ with only a single score as an effective outcome measure following LE specific exercise training in persons with COPD.

The decision to correlate the proposed subscores with the 6MW was made because the 6MW has been tested as a reliable and valid measure of LE functional capacity (Steele, 1996). Therefore, the researchers postulated that a significant correlation with the 6MW may have been an indication that the proposed subscores of the SOBQ may be more effective than the total score in discriminating changes in LE activity tolerance.

Because the 6MW measures a person’s ability to perform the ADL of walking and the proposed LE subscore is composed of activities requiring the sole use of the LE, one would have expected that the two measures would have significantly correlated. Several factors must be considered in effort to explain the study findings. First and foremost, the utilization of data from a prior study limits the evaluation of research questions as part of a secondary analysis. For example, a power analysis conducted for the primary study suggested that a sample size of 24 subjects was needed. However, 24 subjects may have provided insufficient power for this secondary analysis, increasing the chances of committing a type II error. In addition, the primary study was a randomized control trial of an intervention to reduce perception of dyspnea, thereby improving 6MW performance over time. There were significant differences between the experimental and control groups in opposing directions for both 6MW distance and SOBQ score at 4-week and 8-week data collection (Bauldoff, Hoffman, Zullo, and Sciurba, 2002). For this study, both group's data were compiled together to produce an aggregate data set, which may have diluted any effect at each follow up time point. Hence, baseline correlations values (when the sample had yet to undergo experimental conditions) were considered most reflective of the true relationships between 6MW and proposed subscores. Finally, the undercoverage of male subjects and ethnic minorities may have introduced bias into the study and threatened the generalizability of study findings.

To adjust for these aforementioned study limitations, three important recommendations are needed for further study. First, a sample size of 10 subjects per SOBQ item for a total of 240 subjects would provide sufficient power specific for a study of this nature. Next, a cross-sectional study design with each subject completing a single SOBQ and 6MW promises to ensure sample homogeneity and eliminate any dilution effects the music intervention may have had on the sample in the primary study. Lastly, a representative sample consistent with national demographic variables of gender and ethnicity is recommended for re-analysis.

In summary, the SOBQ has been included in several important research studies to evaluate the effectiveness of unique nursing interventions targeting increases in activity tolerance in persons with chronic airflow obstruction. The ability of the SOBQ to discriminate dyspnea related to LE and WB activity when compared to 6MW distance encourages its use in future studies detailing the impacts of LE specific exercise in the COPD patient population. In addition, the novelty of this study should open the door for future studies evaluating the ability of the SOBQ to discriminate changes in dyspnea related to UE activity. Finally, there was insufficient evidence supporting the LE and WB subscores as independent subscores at this time; however, the promising findings suggest that a future study incorporating the aforementioned recommendations may validate the LE and WB subscores as potential revisions to the current design of the SOBQ.

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Appendix

Table 1

Demographic Characteristics of COPD Subjects Recruited from Four Outpatient PRP Sites in Alleghany County, PA (N=24)

Demographic Variables	Total Sample Frequency
FEV_1 % predicted	41.3 (13)*
Gender	
Male	4 (17%)
Female	20 (83%)
Ethnicity	
Caucasian	19 (79%)
African American	5 (21%)
Educational Attainment (highest degree achieved)	
Did not finish high school	3 (13%)
High school diploma	15 (63%)
Two year college degree	2 (8%)
Four year bachelors degree or higher	4 (16%)
Employment Status	
Full time homemaker	9 (38%)
Retired or not working	11 (46%)
Younger than retirement age, disabled, and not working	3 (13%)
Working full time	1 (4%)
Marriage Status	
Widowed	8 (33%)
Married	14 (58%)
Divorced	2 (8%)

*Data presented as mean (SD); all other data presented as frequency (proportion of total sample)

Table 2
Proposed SOBQ Subscores

Lower Extremity (LE) Subscore	Upper Extremity (UE) Subscore	Whole Body (WB) Subscore
Walking on a level at your own pace (2)	While eating (6)	At rest (1)
Walking on a level with others your age (3)	Brushing teeth (8)	Showering/bathing (10)
Walking up a hill (4)	Shaving and/or brushing hair (9)	Sweeping/vacuuming (14)
Walking up stairs (5)	Dressing (11)	Making bed (15)
Standing up from a chair (7)	Picking up and straightening (12)	Shopping (16)
	Doing dishes (13)	Washing car (18)
	Doing laundry (17)	Mowing lawn (19)
		Watering lawn (20)
		Sexual activities (21)

note: number in parentheses represents SOBQ item number

Table 3
Spearman's rho Correlations Between 6MW distance and SOBQ scores

	6MW (Baseline, N=24)	6MW (4 week, N=24)	6MW (8 week, N=24)
LE Subscore	-0.253	-0.133	0.142
WB Subscore	-0.523**	-0.508*	-0.422*
SOBQ Total Score	-0.453*	-0.359	-0.286

*=p<0.05; **=p<0.01