TITLE: Limited evidence to support the use of energy conservation training alone or combined with other pulmonary rehabilitative interventions to reduce fatigue or energy expenditure during select ADL performance was more effective than no treatment on improving walking distance and improving select physiological variables in clients with COPD.

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CLINICAL SCENARIO:

Condition/Problem

Chronic Obstructive Pulmonary Disease (COPD) describes a number of progressive diseases of the lungs including emphysema, chronic bronchitis, and irreversible asthma (Understanding COPD, 2015). COPD occurs when the airflow out the lungs is obstructed. Overtime, the lungs lose elasticity resulting in overexpansion during inhalation and air becoming trapped in the lungs during exhalation. Individuals with COPD most often experience gradually increasing difficulties such as shortness of breath, frequent coughing, wheezing and a tightness in their chest as the disease progresses. People are at an increased risk for COPD if they are exposed to cigarette smoke or long-term exposure to environmental pollutants (Understanding COPD, 2015).

Clients with COPD typically experience a heightened sense of fear related to their symptoms of dypsnea. This sense of fear may hinder participation in activities of daily living and fulfillment of life roles (Chan, 2004). This results in increased isolation and may cause in symptoms of anxiety and/or depression (Living with COPD, 2013).

Incidence/Prevalence

Approximately 6.3% of US adults have COPD (about 24 million people); among those, 5% of people living in WI have COPD (Understanding COPD, 2015). However, half of these people do not get officially diagnosed because they are unaware of the symptoms of COPD and over 800,000 people are hospitalized per year from complications related to COPD (Understanding COPD, 2015).

Impact of the Problem on Occupational Performance

Due to the impact of COPD on air exchange in the lungs, shortness of breath (SOB) is common during the performance of occupations. In early stages of the disease, most clients notice increased production of mucus, difficulty breathing, and SOB during activities such as climbing stairs and engaging outdoor tasks. According to a qualitative study completed by Chan (2004), these early symptoms are often overlooked and are unlikely to be attributed to COPD, but rather as something less chronic such as the flu. However, as COPD progresses, as does the symptom severity. There is an increase of breathlessness during activities of daily living (ADLs) such as feeding, bathing, grooming, and dressing and may even occur at rest (Chan, 2004). Sleep can also be affected due to hypoventilation and reduced use of accessory breathing muscles (Sleep problems COPD, 2015).

The unpredictability and constant threat of breathlessness can be a source of fear, anxiety, and depression (Living with COPD, 2013). Clients begin to prioritize participation in activities. Those activities requiring greater physical demand such as work, social events, and hobbies may be reduced or stopped. The reduced participation in social activities decreases social support and increases social isolation. The inability to work can add financial strain and may result in a weaken sense of purpose. Often clients identify themselves with an abnegated past-time which affects quality of life and can be other agencies of psychological impairment.

Intervention

The participants of a study done by Velloso & Jardim in 2006 received instruction on how to perform four ADL using postures supporting energy conservation. The energy conservation techniques included sitting in a chair with a backrest and arm rests (as opposed to standing to complete tasks) and performing tasks in manners that eliminated the need to bend forward or to bring the arms above the head (Velloso & Jardim, 2006)

The participants of a randomized control trial by Theander, Jakobsson, Jorgensen, & Unosson in 2009 were randomly assigned to either a pulmonary rehabilitation group or a control group receiving traditional therapy. The participants in the pulmonary rehabilitation group received 12 weeks of physiotherapy, for one long sessions two days a week. Individuals exercised in therapy and progressed to an individualized home exercise program in addition to therapy after one month. A dietician educated the patients three times, in weeks 2, 4, and 8, for one hour long session each time. Patients received self-care advice from a nurse during two hour long sessions which occurred at weeks 2 and 4. An occupational therapist educated participants in energy conservation techniques in three sessions, each an hour long, at weeks 2, 4, and 8. In addition, patients were educated in proper breathing techniques by all of the health professionals.

Occupational Therapy Theoretical Basis

A rehabilitative frame of reference is most applicable to clients with COPD, combined with some elements of the biomechanical frame of reference (combined approach). Rehabilitative strategies include energy conservation techniques, changing features of a client's environment to best work with the client's remaining skills, examining a client's roles and helping to modify areas of occupation, and introducing adaptive equipment such as reachers, adapted seating or beds, and dressing/grooming aids (Cole & Tufano, 2008). Biomechanical strategies involve maximizing a client's remaining skill through strengthening, increasing endurance, and positioning of the body during various activities (Cole & Tufano, 2008). The client's progression with COPD may determine how appropriate a biomechanical approach will be.

The articles appraised used a combined rehabilitative/biomechanical approach to treatment, using energy conservation techniques (ECTs) consisting of modifying body position, introducing environmental supports (such as a chair with a backrest as opposed to standing while completing tasks), and breaking up activities into smaller components to be completed in stages. ECTs can be individually taught in the context of specific activities, or can be included

as part of a broader interdisciplinary pulmonary rehabilitation program to reduce pulmonary demand and increase performance of ADLs.

Science Behind the Intervention

Energy conservation techniques are currently used as a treatment in many chronic diseases such as COPD, multiple sclerosis, rheumatoid arthritis, and for clients undergoing cancer treatment. Using a rehabilitative model, ECT modifies a person's activities, positioning during those activities, and can introduce modified breathing strategies (pursed-lip breathing, coordinated breathing) to reduce the client's respiratory demand during activities (Chan, 2004). These strategies can be taught to individual clients or in a group setting (Chan, 2004).

Pulmonary rehabilitation programs provide multiple strategies to address the functional needs of participants (Theander, Jakobsson, Jorgensen, & Unosson, 2009). Due to the breakdown of alveolar walls in clients with COPD, they have poor ventilation in normal tidal breathing--this greatly impacts their ability to participate in activities due to poor endurance. Breathing techniques can be taught as part of a pulmonary rehabilitation program to aid people with COPD in their breathing (Theander, Jakobsson, Jorgensen, & Unosson, 2009). Light aerobic exercise in the context of pulmonary rehabilitation (for 10-15 minutes) aids clients in using accessory breathing muscles which they may not be using in normal tidal breathing (Theander, Jakobsson, Jorgensen, & Unosson, 2009). Activating accessory breathing muscles can help maximize alveolar space by fully inflating the lungs and increasing ventilation. Poor endurance may lead to lessened participation in activities, which can lead to lowered tone in muscles. Strengthening exercises (within a client's limits) helps maintain muscle tone and helps the muscles be as efficient as possible (Theander, Jakobsson, Jorgensen, & Unosson, 2009). Nutritional education from a dietician is also included in a multidisciplinary pulmonary rehabilitation program (Theander, Jakobsson, Jorgensen, & Unosson, 2009).

Why is this Intervention Appropriate for Occupational Therapy?

Energy conservation techniques (ECT) are applicable to occupational therapy; therapists are knowledgeable about activity analysis, grading activities, and ergonomics and body mechanics. Addressing functional concerns in patients with COPD using energy conservation techniques relates to the AOTA framework because it has a focus on occupations, the client factors of body structures and body functions, and performance skills of the person potentially completing activities. The corresponding ICF categories that energy conservation addresses are body functions, activities, and participation.

Pulmonary rehabilitation already includes occupational therapy as part of a multidisciplinary team to address energy conservation techniques (Theander, 2009). Apart from reducing energy expenditure in activities, occupational therapists can also address client factors of anxiety and depression which are often residual problems of COPD. Energy conservation techniques both alone and as part of pulmonary rehabilitation are a form of education and training which are preparatory-based methods which can be applied to later occupational performance.

FOCUSED CLINICAL QUESTION:
Is energy conservation training alone or combined with other pulmonary rehabilitative interventions more effective than no treatment on reducing fatigue or energy expenditure during select ADL performance in clients with COPD?

SUMMARY: This critically appraised topic measures the effectiveness of energy conservation training alone or combined with other pulmonary rehabilitative on reducing fatigue or energy expenditure during select ADL performance in clients with COPD. Eight databases were searched and a total of two relevant articles were found, one determined to be a level 2b and one a level 3b. Articles selected for critique were chosen because they specifically addressed the intervention posed in our PICO question. At this time, there is limited evidence available regarding the use of energy conservation training alone or combined with other pulmonary rehabilitative interventions to address fatigue and energy expenditure.

CLINICAL BOTTOM LINE: Limited evidence to show that energy conservation training alone or combined with other pulmonary rehabilitative interventions to reduce fatigue or energy expenditure during select ADL performance was more effective than no treatment on improving walking distance and improving select physiological variables in clients with COPD.

LIMITATION OF THIS CAT: This critically appraised paper (or topic) has been reviewed by occupational therapy graduate students and the course instructor.

SEARCH STRATEGY:

TABLE 1 : Search Strategies

Databases Searched	Search Terms	Limits Used	Inclusion and Exclusion Criteria
OT Seeker National Guideline Clearinghouse OT Cats Cochrane EBSCO Host PUBmed	COPD and Occupational therapy chronic obstructive pulmonary disease occupational therapy Occupational therapy Fatigue Management COPD fatigue management	Prior to 2005	English Adults with COPD

AOTA Medline	chronic obstructive pulmonary disease pulmonary strategies pulmonary rehabilitation energy conservation techniques COPD energy conservation techniques chronic obstructive pulmonary disease fatigue management techniques COPD fatigue management techniques chronic obstructive pulmonary disease energy management COPD energy management chronic obstructive pulmonary disease		

RESULTS OF SEARCH:

Table 2: Summary of Study Designs of Articles Retrieved

Level	**Study Design/Methodology of Articles Retrieved**	**Total Number Located**	**Database Source**	**Citation (Name & Year)**
Level 1a	Systematic Reviews or Meta-analysis of Randomized Control Trials			
Level 1b	Individual Randomized Control Trials			
Level 2a	Systematic Reviews of Cohort Studies			

Level 2b	Individual Cohort Studies and Low Quality Randomized Control Trials (PEDro < 6)	1	Medline	Theander, K., Jakobsson, P, Jorgensen, N., & Unosson, M., (2009).
Level 3a	Systematic Reviews of Case-control Studies			
Level 3b	Individual Case-control Studies and Non-Randomized Control Trials	1	PUBmed	Velloso, M. & Jardin, J.R., (2006).
Level 4	Case-series and poor quality cohort and case-control studies			
Level 5	Expert opinion (case study, qualitative, editorial, etc.)			

STUDIES INCLUDED:

Table 3: Summary of Included Studies

	Study 1	**Study 2**
Authors	Veloso, M & Jargon, J. R.	Theander, K., Jakobsson, P., Jorgensen, N. & Unosson, M.
Research Design	Repeated Measures	Randomized Controlled Trial
Level of Evidence (Canadian Scale)	3b	2b
Rigor of Evidence (Ratings of Critique Scale)	SNS 2/8	Pedro 4
Purpose of Research	The purpose of this study was to determine how much energy is spent by patients with patients with COPD when completing activities of daily living (ADL) when not using energy	The study was to determine “the effects of pulmonary rehabilitation on fatigue, functional status and health perceptions in patients with chronic obstructive pulmonary disease.”

	conservation techniques (ECT) versus when using ECT.	
Population	N = 16 Adult males (mean age = 62) with moderate to very severe COPD (mean FEV1 = 40%)	N=26 Adults aged 75 years or younger with a forced expiratory volume in 1 second (FEV1) between 60 % and 25% of predicted after bronchodilatation.
Dependent Variables	1. Metabolic functions: A. V_{O2} B. V_{CO2} 2. Ventilatory functions: A. breaths/min 3. Cardiovascular functions: A. HR B. oxygen pulse 4. Dyspnea	1. Fatigue A. Frequency B. Duration C. Severity 2. Functional capacity A. Walking distance B. Grip strength 3. Functional limitations due to fatigue 4. Changes in functional performance and satisfaction over time 5. Health perceptions
Outcome Measures	1. Oxygen and carbon analyzers 2. Stopwatch 3. Pulse meter 4. Borg Scale	1. Structured questions 2. Six-minute walking distance test and Grippit Instrument 3. Fatigue Impact Scale 4. Canadian Occupational Performance Measure 5. St. George's Hospital Respiratory Questionnaire and the Medical Outcomes Survey Short Form 36
Intervention	Patients consecutively completed four exercises including: 1. Personal hygiene activities including washing and drying face, combing hair, brushing teeth and drying the mouth. ● Without ECT: Patient stood in front of sink with unsupported arms. ● Using ECT: Patients sat in a chair with back rest in front of sink with arms rested on sink edge. 2. Putting shoes on and taking	Patients in the pulmonary rehabilitation group worked with multidisciplinary health care professionals (physiotherapist, dietician, occupational therapist and a nurse). Patients saw the physiotherapist for exercise sessions two times a week, for hour long sessions, for 12 weeks. In addition, an at home training program was given after one month to supplement the physiotherapy sessions. A dietician educated patients on

	shoes off ● Without ECT: Seated in a chair, the patients bent to the floor to don and tie each shoe one at a time. ● Using ECT: Seated upright in a chair, the patients slide on each shoe, then crossed ankle over knee to tie the shoe. 3. Storing food bags on high shelves ● Without ECT: While standing, patients moved food bags from a table to shelves above shoulder height. Once complete, they moved the bags back from the shelf to the table. ● Using ECT: 4. Storing food bags on low shelves. Activities were first completed without the use of ECT. Followed by an hour of rest. Then the activities were completed using ECT. Using the ECT	nutrition and gave individualized dietary advice for three one hour sessions at weeks 2, 4, and 8. An occupational therapist educated the patients on energy saving techniques for three hour long sessions during weeks 2, 4, and 8. A nurse gave the patients education about COPD and self-care advice in two hour long sessions during weeks 2 and 4. The entire multidisciplinary team educated patients on breathing techniques.
Control	N/A	The control group did not receive any of the pulmonary rehabilitation interventions nor received care from the multidisciplinary team.
Results (p value and effect size)	<0.05 Effect size cannot be calculated without a control group	p value <0.05 Effect size for the six minute walking test was 0.30. Effect size for the COPM was d = 0.85 for performance and d = 0.95 for satisfaction. No other significant differences were found.
Authors' conclusions	Patients with COPD that use ETC during ADL reduces energy expenditure and dyspnea perceptions.	The patients in the pulmonary rehabilitation group significantly improved their walking distances and had a significant increase in their expressions of their own performance and satisfaction after

		12 weeks of pulmonary rehabilitation. However, the pulmonary rehabilitation program did not have any other statistically significant differences at 12 weeks follow-up between the pulmonary rehabilitation and the control groups.

SYNTHESIS SECTION:
IMPLICATIONS FOR PRACTICE, EDUCATION and FUTURE RESEARCH

PICO Question

Is energy conservation training alone or combined with other pulmonary rehabilitative interventions more effective than no treatment on reducing fatigue or energy expenditure during select ADL performance in clients with COPD?

Overall Conclusions

Fatigue for the purposes of this summative research was defined as "a subjective and a whole body experience that interferes with an individual's ability to function at normal capacity" (Theander, Jakobsson, Jorgensen, & Unosson, 2009, pg. 126). Levels of fatigue were assessed through subject answers to structured questions as well as energy expenditure analysis through metabolic, respiratory, and cardiac (physiological) variables. Self-perceptions of health and fatigue, functional limitations due to fatigue, and satisfaction of performance were also taken into consideration.

Results organized by variables:

- Fatigue was broken up into frequency, duration, and severity of perceived fatigue and measured by scaled structured questions. Theander, Jakobsson, Jorgensen, & Unosson found that no significant changes were found for any component of fatigue in the group that received pulmonary rehabilitation, but that the control group reported a statistically significant decrease in the frequency of fatigue (2009).
- Walking distance as measured by the 6MWD assessment showed significant improvement in the group receiving pulmonary rehabilitation, but the significant change was still below the threshold of clinical importance (Theander, Jakobsson, Jorgensen, & Unosson, 2009).
- No significant differences were found in the intervention group for the variables of functional limitations due to fatigue, grip strength, or health perceptions (assessed by the St. George's Hospital Respiratory Questionnaire & Medical Outcomes Survey Short Form 36) after an intervention of pulmonary rehabilitation (Theander, Jakobsson, Jorgensen, & Unosson, 2009).
- Perceived performance and satisfaction in participating for individualized activities (measured by reported COPM scores) significantly increased after 12 weeks of pulmonary rehabilitation (Theander, Jakobsson, Jorgensen, & Unosson, 2009).

- No significant differences were found after using energy conservation techniques for four ADL activities (personal hygiene tasks, donning/doffing shoes, storing food bags on high shelves, and storing food bags on low shelves) for the variables of respiratory rate or respiratory quotient (VCO2/VO2) (Velloso & Jardim, 2006).
- Dyspnea was significantly reduced across all four ADL activities (as reported by Borg score) after using energy conservation techniques (Velloso & Jardim, 2006).
- VO2 and VCO2 (as read by analyzers on a face mask worn throughout the activities) was significantly reduced for three out of four activities using energy conservation techniques (all but donning/doffing shoes) (Velloso & Jardim, 2006).
- Heart rate during activities (read by a pulse meter) was significantly reduced for two of the four activities after using energy conservation techniques (personal hygiene and storing food bags on low shelves) (Velloso & Jardim, 2006).
- Total minute ventilation (CO2 expired after one minute; read by the face mask) and oxygen pulse (measured by dividing VO2 by heart rate) was significantly reduced in when storing food bags on low shelves after applying energy conservation techniques, but not for other activities (Velloso & Jardim, 2006).

There is limited evidence to support that energy conservation training alone or combined with other pulmonary rehabilitative interventions reduce fatigue or energy expenditure in select ADL performance in clients with COPD. Current research shows evidence of level IIb (one article) and IIIb (one article). Lack of evidence may be the result of poorly designed studies with small sample sizes, lack of thorough statistical reports, and lack of control groups.

Boundaries

42 participants were a part of the two studies appraised. Participants ranged in age 37-74 with a mean age ranging from 62-66 years of age. 31% of the participants between both studies were female (n=13), with the remaining 29 participants being male; this breakdown seems to be consistent with prevalence of COPD among the general population (Centers for Disease Control and Prevention, 2010). Participants were not included in the studies appraised if they had a severe or disabling disease other than COPD, cancer, impaired pulmonary function due to another disease, untreated obstructive sleep apnoea syndrome, if they were on long-term oxygen therapy, or less than a 25 on the Mini Mental State Examination.

Implications for Practice

While some variables changed as a result of energy conservation training alone or as part of a pulmonary rehabilitation protocol, neither study collected data for long-term effects. One session of 1-3 hours of individualized energy conservation training achieved results on some physiological components during ADL performance, particularly when the energy conservation included seated rather than standing activities or when modifications to the activity were made to prevent bending at the waist.

The studies showed that as little as a single session of energy conservation training or as much as 12 weeks of education included in a pulmonary rehabilitation context may help to reduce dyspnea, energy expenditure (physiological variables of oxygen consumption and carbon

dioxide production), and perceived performance of select activities. Further research is needed to determine the long-term effects of energy conservation techniques on fatigue management during ADLs for adults with COPD.

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