Exercise Self-Efficacy, Habitual Physical Activity, and Fear of Falling in Patients with Coronary Heart Disease

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Editorial

What is Cardiovascular/Pulmonary Physical Therapy Research and Why Should We Care About it?

The December issue of the *Journal* is one that I always highly anticipate because the CSM 2010 research abstracts are published in this issue. The variety and quality of these abstracts truly excites me about our specialty. From mechanistic studies, we can learn how the body reacts to stimuli like exercise, stress, or nutritional status. We can learn how diseases affect the different cells, tissues, and organ systems of the body. The next step is to translate these findings into human studies. Experiments with participants who do not have cardiovascular or pulmonary diseases help us understand how a human reacts to these stimuli. We can also learn important things about disease prevention from this work. Applying findings in "healthy" people to what we see in our clinical populations is also a critical step in this research continuum. It is only in studying how people react in their own environments that we can use the research to improve function and quality of life for those we serve. Similarly, a well-described and systematically analyzed case report can form the basis of new studies.

I firmly believe that participation in research is vital for the students I teach for two reasons. One, it makes them appreciate the work that goes into the literature they are reading and critiquing. It is one thing to criticize a study for having a small sample size, and fully another to recognize how hard it was to recruit those 8 people for a 6-month training study! Secondly, participating in research helps to "demystify" the process. I hope my students leave school feeling like they could participate in research once they are full-time clinicians. This may be as a person who recruits participants, or performs data collection, but it may also be the person who creates the research ideas and leads the team.

For clinicians who are being pushed to generate more revenue, see more patients, and do more paperwork in their daily lives, the idea of participating in research may just feel impossible. However, I think the same two reasons (if not more) apply to clinicians as to entry-level students. I hope that exposure to the variety of scholarship present in our Journal (and others) might make this idea seem possible. I encourage you who are in this position to find a mentor or like-minded colleague and plunge into the process of discovery. All types of studies are important for our profession and specialty. Each has its strengths and weaknesses. No individual clinician or researcher is an expert in all types of studies. Thus, we depend on a pool of experts to help guide us. I know that is certainly the case for me. I lean heavily on my Associate Editors and Editorial Board. However, we cannot do our jobs without the talented and diverse cadre of reviewers who carefully examine each manuscript and provide clear and constructive comments to the authors. The names of all our reviewers in 2009 are printed below and I encourage you to thank them also. Their dedication to promoting cardiovascular and pulmonary research and developing researchers is unparalleled. I hope you find inspiration in the state of cardiovascular/pulmonary physical therapy research!

Anne K. Swisher PT, PhD, CCS
Editor-in -Chief

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Exercise Self-Efficacy, Habitual Physical Activity, and Fear of Falling in Patients with Coronary Heart Disease

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ABSTRACT

The purpose of this study was to determine if a relationship exists between self-efficacy for physical activity and other pertinent factors in patients with coronary heart disease (CHD). A secondary purpose of this study was to determine if self-efficacy and exercise behavior are different in patients who report a fearing of falling (fallers) as compared to patients who do not report a fear of falling (non-fallers). This study included 50 patients who were admitted to the hospital for a CHD related diagnosis. Patients completed assessments of cardiac self-efficacy (Modified Barnason Efficacy Expectation Scale) and exercise behavior self-efficacy (Self Efficacy for Exercise Behavior Scale). In addition, the Physical Function subscale of the RAND 36-Item Health Survey and the Telephone Interview of Cognitive Function were used to characterize physical and cognitive function, respectively. Data analysis consisted of descriptive statistics, correlations, t-tests, and chi-square. Older patients reported higher levels of cardiac self-efficacy. Further, a positive correlation was found between cardiac self-efficacy and pre-hospitalization level of physical function. Patient income level and Self-efficacy for Exercise Behavior Resisting Relapse subscale scores were significantly correlated. A higher percent of fallers failed to meet minimum exercise guidelines as compared to non-fallers. It is important to identify the factors that are associated with exercise self-efficacy to improve health behavior adoption and adherence in patients with CHD.

Key Words: coronary heart disease, self-efficacy, exercise, cardiac rehabilitation

INTRODUCTION

Purposeful exercise and increased habitual physical activity are important lifestyle components for patients with coronary heart disease (CHD). These behaviors have many benefits for patients with CHD including increased aerobic capacity, quality of life, anginal threshold, and ability to carry out daily activities and live independently. Exercise is also important in the secondary prevention of CHD. Current recommendations suggest that a comprehensive exercise program, including aerobic, flexibility, and strength training components, is most beneficial for patients with CHD.[1,2] Many factors influence patients' ability to engage in exercise such as lack of time, fear of injury, and considering it unimportant.[3,4] To assist a patient in successfully implementing and maintaining an exercise program to reduce cardiac mortality and morbidity, health care professionals need to consider many individual factors including learning preferences and barriers, access to and competence with equipment, current level of knowledge, and attitudes about, barriers to, and self-efficacy for exercise.[5-7]

Participation in outpatient cardiac rehabilitation (CR) is sometimes a viable option for patients with CHD to facilitate adoption of exercise, but disappointingly, is not universally embraced by all eligible patients or referring physicians.[8] Fewer than half of all patients who are eligible for outpatient CR programs actually enroll after being discharged from acute care hospitals.[9,10] Many patients do not attend CR because they have negative perceptions of their control over health. Still others do not attend due to financial constraints imposed by inadequate health insurance and inability to pay for such services.[11,12] Limited accessibility (transportation, distance, winter weather) to outpatient CR services may also restrict many patients from participating in organized exercise sessions after hospital discharge.[13,14] Other important factors that prevent enrollment in an outpatient CR program are return to work and lack of physician referral.[1]

Despite the benefits, many patients with CHD do not adhere to regular participation in CR or unsupervised exercise programs because they have low self-efficacy for participation in and adherence to a program of regular exercise.[15,16] Self-efficacy is a cognitive mechanism that mediates behavior change, influences participation in various activities, and determines the amount of effort and degree of persistence in pursuing the activity despite aversive stimuli. Self-efficacy is defined as an individual's judgment of their capability to organize and execute actions needed to perform an activity, and is largely influenced by past performance and accomplishments, or mastery experiences.[17] Oka et al[18] found that self-efficacy was the strongest mediating influence on physical activity level, and a better predictor of physical activity than peak oxygen consumption or perceived exertion during physical activity. According to Bandura,[17] if people lack the self-efficacy for a behavior, they will likely behave ineffectually, even if they know what to do and how to do it. For example, older women (n = 32)

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with heart failure who participated in a 12-week, home-based, self-monitored, low- to moderate-intensity walking program showed improved self-efficacy for exercise, in addition to 6-minute walk distance, depressive symptoms, and quality of life as compared to a non-exercising control group.[19] Previous studies suggest that a strong relationship exists between self-efficacy and exercise behavior, functional status, quality of life, and social support in patients with CHD.[18-24] Structured exercise programs need to emphasize educational and patient monitoring methods that promote patient self-efficacy for independent exercise because highly supervised programs may impair self-efficacy for independent exercise.[25] In a randomized study, Carlson et al[25,26] found that low-to-moderate risk patients with CHD who participated in modified CR that provided strategies for transition to independent exercise (3 sessions per week, 4 weeks; tapering directly supervised sessions for 20 weeks) had higher levels of exercise self-efficacy and adherence than those who participated in traditional CR (3 sessions per week, 3 months, continuous ECG monitoring). Many factors intertwine to contribute to a sense of self-efficacy regarding a specific behavior.[17] Therefore, it is important to understand factors that may influence self-efficacy for exercise in patients with CHD.

Previous falls and/or loss of balance, and the subsequent fear of falling, may contribute to real or self-imposed activity restriction and sedentary behavior. In 2006, Stretton et al[27] conducted a study to assess the relationships between physical function, self-efficacy, and health-related quality of life. Their study included 243 subjects who were assessed using 3 performance-based measures of physical function (Timed Up and Go Test, Gait Speed, and Berg Balance Scale), and 5 self-report measures, including the Modified Falls Self-efficacy Scale, at 3 and 6 months. They found that falls self-efficacy was the single highest predictor of physical function. Kressig and colleagues[28] found significant relationships between fear of falling and multiple performance-based measures of function in 287 subjects 70 years of age and older who were transitioning to frailty. Interestingly, Kressig et al[28] did not find an association between activity-related fear of falling and age in this sample of older adults. Recently, Gillespie and Freidman found that 76% of older adults who reported fear of falling modified their activity level secondary to this fear.[29]

Little is known about the relationships between exercise self-efficacy and age, socioeconomic status, prior physical function, cognition, and fear of falling in patients with CHD. Therefore, the purpose of our study was to determine if a relationship exists between exercise and cardiac self-efficacy in relation to demographics, cognitive function, or prior physical function in patients with CHD. A secondary purpose of this study was to determine if self-efficacy and exercise behavior are different in patients who report a fear of falling (fallers) as compared to patients who do not report a fear of falling (non-fallers).

METHODS

Subjects

Study participants (n = 50) were volunteers prospectively recruited from Sacred Heart Medical Center, a regional medical center in the northwestern United States. Prior to study participation, patients were screened for inclusion and exclusion criteria. The study inclusion criteria were hospital admission due to a CHD-related diagnosis, ability to follow directions, ability to understand English, and emotionally stable. Exclusion criteria included cardiac transplantation or ventricular assist device placement, cardiac arrhythmia or heart failure without concurrent diagnosis of CHD, isolation precautions in place, and/or cognitive deficit (< Level 6 on Rancho Los Amigos Level of Cognitive Functioning Scale).

Procedures

Volunteers meeting study criteria were first provided an informed consent document, which was approved by St. Luke's Rehabilitation Institute's Institutional Review Board, to read and sign. Pertinent background demographic and medical information was obtained via chart review and history taking. Information used in data analysis included age, body mass index, income, education level, fear of falling, and exercise habits. Fear of falling was scored as nominal data (yes or no) and determined by an affirmative answer to 1 or more of 3 questions which were:

1. Are you afraid of falling?
2. Do you limit any household activities because you are worried you may fall?
3. Do you limit any outside activities because you are worried you may fall?

Meeting minimum exercise guidelines was scored as nominal data (yes or no) and determined by report of 30 minutes or more of activity that elevated heart rate on at least 3 days per week.

Data collection involved completion of a packet of self-report questionnaires and administration of the Telephone Interview of Cognitive Status by a study investigator. The time to complete the self-report questionnaires was not restricted, and the order was randomly determined. The self-report measures used in the study included the Barnason Efficacy Expectation Scale, the Self-Efficacy for Exercise Behavior Scale, and the Physical Function subscale of the RAND 36-Item Health Survey. All data collection took place during the patient's hospital admission in his or her room during a single session lasting approximately 1 hour. The instruments used in this study will be briefly described.

Instruments

The *Telephone Interview for Cognition Status* is a brief interview assessment of cognitive function that can be administrated in person or over the telephone. It is more sensitive to subtle changes and shorter than other instruments.[30] The scale consists of 39 items rated on a nominal scale creating a range of 0-39, with higher scores indicating better cognitive function. In older adults, the Telephone Interview for Cognitive Status was highly correlated with the Mini Mental State Exam (r = 0.57), and the Cambridge Cognitive Examination (r = 0.62), which are more widely used tests of cognition.[30] Furthermore, this instrument was able to differentiate patients with Alzheimer's disease from

healthy controls.[31] Crooks et al[32] compared the Telephone Interview for Cognitive Status to the criterion measurement of cognitive impairment (in-person clinical assessment) and found that this instrument was able to identify people with dementia and cognitive impairment (kappa = 0.89). The threshold value for diagnosing dementia using the Telephone Interview for Cognitive Status is < 15.[33] This instrument has been previously used to evaluate patients who had undergone CAB surgery and was sensitive to differences between groups in cognitive function.[34]

The *Self-Efficacy for Exercise Behavior Scale* is an instrument that was developed to evaluate self-efficacy for exercise behavior adoption and maintenance in a wide range of populations. It is comprised of 2 subcategories, Self-Efficacy for Resting Relapse, which contains 5 items, and Self-Efficacy for Making Time, which contains 6 items. Each item on the Self-Efficacy for Exercise Behavior Scale elicits perceived self-efficacy by asking how confident the respondent is that he could exercise under specific circumstances using a 5-point ordinal scale (0 = Not sure I could do it, 5 = Sure I could do it). Percentage scores are calculated and higher scores indicate better self-efficacy than lower scores. Scores less than 70% on the Self-Efficacy for Exercise Behavior Scale are purported to be associated with drop out behavior.[35]

The *Barnason Efficacy Expectation Scale* is a 15-item instrument developed to measure self-efficacy for return to activity and adoption of secondary prevention behaviors in patients recovering from coronary artery bypass surgery. In this study, a subset of 8 items from the Barnason Efficacy Expectation Scale was used. These 8 items were not specific to recovery from surgery, and were related directly to physical activity. Each item on the scale included a positively worded statement, which was rated on a 4-point ordinal scale (1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree). Scores on each item were summed to create a total score that ranged from 8-32, with lower scores indicating low self-efficacy, and higher scores indicating strong self-efficacy for resumption of physical activity.[36]

The *RAND 36-Item Health Survey* (RAND 36-IHS) and its equivalent, the Short Form 36 (SF-36) are self-report measures of health-related quality of life. These instruments were developed as part of the Medical Outcomes Study, a 4-year observational study that included over 2,500 patients. The RAND 36-IHS consists of 36 items and generates 8 subscales.[37] The 10 item Physical Function subscale was used in this study. Scores on the RAND 36-IHS are converted to a percent score, with higher values indicating greater health status. This instrument has been used extensively to study generic health-related quality of life in patients with cardiac problems.[38] In addition, measurements obtained with these instruments have well documented degrees of reliability, validity, and sensitivity.[39]

Data Analysis

Descriptive statistics for study participant demographic data and all study measurements were calculated. A correlational matrix was generated using Pearson Product Correlations for all study variables (cognitive function, physical function, age, body mass index, income, education level, exercise self-efficacy, and cardiac self-efficacy). Based on the dichotomized data regarding fear of falling, study participants were divided into 2 groups for analysis, those who reported a fear of falling (fallers) and those who did not (non-fallers). We used t-tests to determine if there were differences in the study variables between these groups of subjects. Chi Square analysis was used to determine if differences in frequency were found between study participants categorized as fallers vs. non-fallers. The alpha level was set at 0.05.

RESULTS

A majority of the study participants were men (66%) and retired (65%). Table 1 provides descriptive data on the study participants. Descriptive statistics were calculated for the Self-Efficacy for Exercise Behavior instrument, and for both of the subcategories. Participant scores on the full instrument were (Mean ± SD) 55 ± 24%, with a range of 2-100%. Participant scores on the Self-Efficacy for Exercise Behavior Scale, Resisting Relapse subcategory, were 60 ± 25%, with a range of 5-100%. Participant scores on the Self-Efficacy for Exercise Behavior Scale, Making Time subcategory, were 52 ± 25%, with a range of 0-100%. Descriptive statistics for the Barnason Efficacy Expectation Scale were 25 ± 4, with a range of 17-32.

Table 1. Study Participants' Demographic Data

Variable	Mean (± SD)	Range	Frequency (%)
Age (years)	65 ± 1.6	37 - 94	
BMI (kg/m^2)	31 ± 1	20 – 48	
Physical Function (%)	42 ± 4	0 – 100	
Cognitive Function	22 ± 0.7	12 – 33	
Annual Income			
< $19,000			21
$19, 000 - 32,000			16
$32,000 - $51,000			28
$51,000 – 64,000			16
$64,000 – 77,000			7
$77,000 – 100,000			5
> $100,000			7
Highest Level of Education			
Junior High School (8th Grade)			6
High School Graduate			50
Technical / Vocational School			20
Bachelor's Degree			14
Graduate Degree			10
Admitting Diagnosis			
Coronary Heart Disease			100
Coronary Artery Bypass Surgery			16
Cardiac Valve Surgery			10
Arrhythmia			14
Heart Failure			4
Aortic Aneurysm			4

Correlations for scores between study variables are presented in Table 2. The Self-Efficacy for Exercise Behavior Scale Resisting Relapse subscore was positively correlated with income level. The Barnason Efficacy Expectation Scale score was positively correlated with age and RAND 36-IHS Physical Function subscale score. No other significant correlations were found between measurements.

When comparing subgroups of study participants (see Table 3), no differences were found between fallers (n=20) and non-fallers (n=30) on any of the measurement scores. However, a significantly lower percentage of fallers (25%) met minimum exercise guidelines as compared to non-fallers (57%).

DISCUSSION

Subject mean scores on the Self-Efficacy for Exercise Behavior Scale were less than 70% suggesting that study participants had an increased risk for exercise drop out. Since this instrument was developed using a sample of adults from the general population, these results are not surprising.[35] Patients with CHD are in poorer health than their age or gender mates in the general population, and often have additional co-morbidities. People with CHD also have an increased incidence of depression compared to the general population. We postulate that making the time and expending the energy to build exercise into one's daily routine is difficult for healthy adults, and possibly even more so for those with CHD who have a limited energy reserve due to impaired cardiac function. Sarkar and colleagues[40] found that lower cardiac self-efficacy was associated with greater symptom impact, more impaired physical function, lower quality of life, and lower health status in patients with CHD.

The correlation between exercise self-efficacy for resisting relapse and income suggests that patients with higher income were more confident in adhering to exercise, even when barriers were present. This finding may be due to several factors, including that people with higher income have more time and resources available to support and maintain exercise behavior, even when external factors like household chores, work requirements and/or social obligations are present. These findings are consistent with those of Clark et al,[41] who found that exercise self-efficacy is positively correlated with income. It is also possible that individuals with higher income levels have less physically demanding jobs, resulting in less fatigue at the end of the work day, and therefore more energy to engage in exercise. However, the majority of study participants were retired, so it would be important to consider the relationship between physical work demands and adherence to exercise in a population of adults with CHD who are in the workforce.

Study findings also suggest that participants with higher physical function were more confident returning to physical activity and managing any cardiac-related symptoms experienced. Patients with lower physical function may have a limited repertoire of physical activities in which to

Table 2. Correlations (*R*) Between Self-Efficacy Measurement Scores and Other Variables

Variable	Self-efficacy for Exercise Behavior Scale – Resisting Relapse	Self-efficacy for Exercise Behavior Scale – Making Time	Barnason Efficacy Expectation Scale
Age	- 0.13	0.08	0.27*
Income	0.26*	0.14	0.01
Education	0.04	0.01	0.17
Body Mass Index	0.15	- 0.11	0.15
Physical Function	0.16	0.18	0.25*
Cognitive Function	0.08	0.02	0.03
*P<0.05			

Table 3. Mean And Standard Deviation Scores for Fallers and Non-fallers

Variable	Fallers (n = 19)	Non-fallers (n=31)
Self-efficacy for Exercise Behavior Scale – Resisting Relapse (%)	60 ± 26	60 ± 24
Self-efficacy for Exercise Behavior Scale – Making Time (%)	61 ± 30	63 ± 30
Barnason Efficacy Expectation Scale	72 ± 19	70 ± 17
Physical Function (%)	37 ± 32	46 ± 29
Meeting Minimum Exercise guidelines	25%	57%*
*P<0.05		

engage, and may be less likely to independently engage in previous physical activities after a cardiac event. This notion is easily conceivable and very well supported by previous research in a variety of patient populations.[42-45] However, people with low physical function might actually have the greatest gains in self-efficacy after engaging in physical activity. Interestingly, less fit, sedentary, and older individuals have been shown to achieve greater improvements in exercise self-efficacy following an exercise trial when compared to younger, more fit individuals, regardless of the intensity of the exercise bout (55% vs. 70% maximum oxygen consumption).[46,47]

Study results also indicate that older participants were more confident in their ability to return to physical activity and manage potential symptoms. It is possible that age brings experience in coping with health problems, and that in turn, those coping skills would better prepare older adults to engage in physical activity. Life experience and coping skills may help increase a patient's confidence about engaging in exercise safely, or when to contact his or her physician, for example. In a previous study, older patients recovering from coronary artery bypass surgery reported less decline in activities of daily living ability and health-related quality of life than younger patients despite more comorbidities and lower health status.[48] In our study patients admitted for initial diagnosis of CHD and those admitted for exacerbation of previously diagnosed CHD were not differentiated. Another plausible explanation for the positive relationship between age and cardiac self-efficacy is that as age increases most likely so does the length of time since initial diagnosis of CHD. Over time patients may acquire self-management skills for exercise participation despite experiencing symptoms related to CHD or other chronic conditions.[49,50]

Our results illustrate that less than 60% of study participants met minimum exercise guidelines prior to hospital admission. These results show that participants were not exercising as much as they should be, especially considering the importance of exercise in light of their CHD. Our definition was more conservative than the current recommendation that individuals accumulate at least 30 minutes of moderate intensity physical activity 5 days per week to reduce disease risk.[51,52] Despite these recommendations, only about 15% of adults in the United States engage in regular physical exercise,[53] and of those who begin an exercise program, 50% will drop out within 3 to 6 months.[54]

In addition, results illustrate that 57% of non-fallers met minimum exercise guidelines, while only 25% of fallers met such guidelines. The significant difference between these groups in meeting minimum exercise guidelines suggests that previous falls and/or loss of balance, and the subsequent fear of falling, may contribute to real or self-imposed activity restriction and sedentary behavior. Previous studies have demonstrated a relationship between balance/fear of falling and physical activity.[27,29] The relationships between physical function, confidence in ability to return to physical activity, and fear of falling clearly exist, and warrant further investigation.

Our research has assisted in identifying correlations between age, income, physical function, and components of self-efficacy for exercise. Bandura's[17] social cognitive theory suggests that self-efficacy can be increased in 4 principle ways: mastery experiences, social modeling, persuasion, and reducing negative reactions. Future investigation of the specific factors influencing exercise self-efficacy in patients with CHD is important, and will enable health care professionals to implement strategies to improve self-efficacy in concert with Bandura's theory. By breaking down barriers to adopting exercise and habitual physical activity, health care professionals can promote wellness and secondary prevention in this patient population so in need of improved health. Possibly by indentifying patients with low exercise self-efficacy and low habitual physical activity prior to hospital discharge; interventions can be implemented for those individuals most at risk for sedentary behaviors. With rationing of health care resources it is important to determine who would benefit most and from what type of rehabilitation services.

Several factors must be considered when interpreting the results of this study. This was a cross-sectional study and therefore results cannot be extrapolated to describe the evolution of change in exercise and activity self-efficacy in patients with CHD. For example, some study participants may have been recently diagnosed with CHD, while others may have already received the benefits of cardiac rehabilitation prior to this hospital admission. In addition, since the participants in this study were hospitalized, their medical acuity may have artificially altered their self-efficacy scores. It is possible that during hospitalization a patient with CHD may become recommitted to exercise behaviors due to his current medical event. It is equally plausible that a patient hospitalized for CHD may feel her health is worse than previously thought and therefore have low self-confidence for physical activity. Additionally, the patients with CHD in this study may represent a biased sample, since only patients who elected to volunteer for participation could be included in data collection. Lastly, it is important to note that although several correlations were found to be significant, their values indicate only a moderate relationship ($r < 0.50$) between variables.

CONCLUSION

Study results suggest that patients with CHD are at risk for exercise drop out, and many fail to meet minimum exercise guidelines. Further, patients with higher income may have more resources to support their exercise adherence. Patients with lower physical function are less likely to independently engage in previous physical activities after a cardiac event compared to those with higher physical function. Results also may indicate that age brings experience and possibly confidence in coping with physical impairments. The majority of fallers failed to meet minimum exercise guidelines, indicating that fear of falling may contribute to activity restriction. It is important to identify factors that are associated with exercise self-efficacy. While multiple factors may contribute to higher or lower self-efficacy within a specific patient population, strategies to increase self-efficacy and patients' participation in their own care should be implemented.

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Exercise Training in Patients with Pulmonary Arterial Hypertension: A Case Report

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ABSTRACT

Purpose: To describe the benefits of a feasible, outpatient exercise training program on exercise tolerance and health-related quality of life (HRQL) in individuals with pulmonary arterial hypertension (PAH). **Methods:** Case report on two subjects recruited from a tertiary care pulmonary hypertension clinic. Subject 1 was a 50-year-old male with idiopathic PAH. Subject 2 was a 54-year-old female with a 20+ year history of scleroderma and 6-year history of PAH. Both subjects underwent exercise training 3 times per week for 6 weeks using a cycle ergometer at workloads progressing from 50% to 80% of peak workload. Outcomes were assessed using cardiopulmonary exercise testing, six-minute walk test (6MWT), and HRQL using the Chronic Respiratory Disease Questionnaire (CRQ) and the Cambridge Pulmonary Hypertension Outcome Review (CAMPHOR). **Results:** Both subjects made substantial improvements in oxygen consumption and workload at anaerobic threshold (improvements of 3.8 and 4.2 $mL \cdot kg^{-1} \cdot min,^{-1}$ 26 and 18 W, respectively) and 6MWT distance (from 496 to 586m and 416 to 517m, respectively). Only Subject 1 made substantial improvements in peak oxygen consumption (from 16.0 to 18.3 $mL \cdot kg^{-1} \cdot min^{-1}$and from 15.0 to 15.6 $mL \cdot kg^{-1} \cdot min,^{-1}$ respectively) and peak work rate (from 112 to 130W and 66 to 69W, respectively). Both subjects demonstrated improved HRQL. No adverse events were noted. **CONCLUSIONS:** A short and practical exercise training program can improve measures of workload, aerobic capacity, and HRQL in individuals with PAH with no adverse effects shown in these two case studies.

Key Words: pulmonary arterial hypertension, exercise training

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BACKGROUND AND PURPOSE

Pulmonary arterial hypertension (PAH) is characterized by elevated pulmonary vascular resistance that subsequently leads to right heart failure. The etiology of PAH is varied. World Health Organization (WHO) Group I PAH includes those individuals with idiopathic, familial, collagen vascular, HIV, portal hypertension, congenital systemic-to-pulmonary shunt, and anorexigen-induced disease etiologies due to their similar histopathological features.[1] These are characterized by intimal proliferation, medial thickening, and ultimately plexiform lesions of the pulmonary artery vasculature.[1,2] It is defined by a mean pulmonary artery pressure >25 mmHg at rest or >30 mmHg with exercise and a pulmonary capillary wedge pressure <15 mmHg.[3,4] Archer and Michelakis[5] have advocated for an elevated pulmonary vascular resistance of >3 Wood units as a third diagnostic criterium. For individuals with scleroderma, PAH occurs without interstitial lung disease/lung parenchymal involvement. The overall prevalence of PAH in the U.S. is difficult to ascertain due to increasing recognition of PAH, lack of a single classification and coding schema for PAH, and different sources of prevalence data.[6] However, the prevalence of PAH has been suggested to be approximately 30 to 50 per million.[7]

Initial presenting symptoms include exertional dyspnea, as well as fatigue, weakness, chest pain, and syncope.[8] Individuals with PAH report substantial reductions in health-related quality of life (HRQL)[9,10] and demonstrate dyspnea on exertion with moderate-to-severe limitations in exercise tolerance.[11,12] The dyspnea and limited exercise tolerance are due to impaired gas exchange associated with ventilation-perfusion mismatching, as well as reduced pulmonary venous return with subsequent reduction in cardiac output. This results in arterial hypoxemia (especially if pulmonary-to-systemic shunting due to patent foramen ovale is present), reduced oxygen delivery to exercising muscle, reduced maximal oxygen consumption, early onset of anaerobic metabolism, and subsequent increased demand for ventilation.[11,12] The degree of limitation is proportionate to disease severity.[11] Further, there may also be significant inspiratory muscle dysfunction[13] and altered pulmonary mechanics.[14]

Current management of PAH emphasizes management of the underlying disease process through the use of selective pulmonary arterial vasodilator and antiproliferative agents.[15] This pharmacologic approach has improved survival by 50% at 2 years to over 50% at 5 years in individuals with idiopathic and familial PAH[16] but is not curative of the disease process. Pharmacologic management has also been shown to improve exercise tolerance and improve New York Heart Association Functional Class (NYHA-FC).[17,18] However, because this is an incurable disease, there remains a need to investigate other interventions such as exercise training that may improve functioning and HRQL to a greater degree than pharmacologic management alone.

Although the benefits of exercise training for individuals with chronic obstructive pulmonary disease (COPD) and chronic heart failure (CHF) have been well studied and demonstrate both safety and efficacy with respect to exercise tolerance, improved functional status, and improved HRQL,[19-25] the benefits for those with PAH are less clear. In fact, exercise training was previously considered a contraindication due to concerns of low cardiac output, arrhythmias, pulmonary venous congestion, and hypoxemia.[26,27] However, recent attention has begun to be given to the importance of exercise in preparation for transplantation for reducing functional limitation.[27] Aerobic exercise training in individuals with PAH is directed at improving aerobic capacity of skeletal muscle, thus compensating for reduced diffusing capacity and cardiac output. In individuals with COPD and CHF, this results in increased exercise tolerance, reduced dyspnea, and improved function,[19-25,28] and similar mechanisms and responses may be found in those with PAH.[29,30]

Uchi et al[29] demonstrated that a 6 to 8 week course of inpatient cardiopulmonary rehabilitation following the start of intravenous prostacyclin resulted in improvements in NYHA-FC, lower extremity strength, six-minute walk test (6MWT) distance, and ADL status. There was no assessment of aerobic capacity using gas exchange data measured using cardiopulmonary exercise testing (CPET) or measurement of HRQL. They did not observe any adverse effects as measured by echocardiography and plasma levels of human atrial natriuretic peptide and brain natriuretic peptide. Mereles et al[30] demonstrated that a 15 week, comprehensive rehabilitation program resulted in improvements in exercise tolerance measured using CPET, functional exercise tolerance measured by the 6MWT, HRQL using the Medical Outcomes Short Form 36 (SF-36), and WHO Functional Class (WHO-FC). Interventions including cycle ergometry, walking, resistance training, breathing instruction, and respiratory muscle training were initiated during an elective 3 week in-patient hospital stay, and continued in a home-based program for the remaining 12 weeks. They did not observe any deleterious effects using echocardiography and right heart catheterization.

Pulmonary arterial hypertension is a devastating disease that, despite optimal pharmacologic management, results in considerable limitations in function and HRQL. Only preliminary work by Uchi et al[29] and Mereles et al[30] have studied the potential for exercise training as an important adjunct in the comprehensive management of PAH, and both have limitations with regard to feasibility and confounding factors. The study by Uchi et al[29] was limited to individuals with idiopathic PAH starting on intravenous therapy and the study protocol was entirely performed on an inpatient basis. The study by Mereles et al[30] required patients to perform the first 3 weeks of the exercise program as an inpatient. The intervention provided in the studies by both Uchi et al[29] and Mereles et al[30] included multiple interventions that could confound the effect of exercise training on the study outcomes. Therefore, the purpose of this case report is to describe the potential benefits of a short, feasible outpatient exercise training program on exercise tolerance and HRQL in individuals with PAH.

CASE DESCRIPTIONS

We describe the first 2 cases included in a prospective case-series study designed to evaluate the effects of exercise training in patients with PAH. The study was approved by the Spectrum Health and Grand Valley State University institutional review boards. Inclusion and exclusion criteria required that patients have stable WHO Group I PAH on optimized medical therapy and have no evidence of left heart disease, interstitial lung disease confirmed by chest radiograph or CT scan, or obstructive lung disease that contributes to exercise limitation.

Procedures

Both subjects were recruited from a tertiary care pulmonary hypertension clinic under the clinical care of one of the authors (JW) and provided written informed consent prior to any study procedure. Baseline testing included 2 HRQL measures, a 6MWT, and cycle ergometry CPET using a ramp protocol.

Health-related quality of life was measured using the Chronic Respiratory Disease Questionnaire (CRQ)[31,32] and the Cambridge Pulmonary Hypertension Outcome Review (CAMPHOR).[9,33] The 6MWT[34-36] was used as a submaximal measure of functional exercise tolerance and was administered on a 100 foot hallway course, with standardized instructions and encouragement as recommended by the American Thoracic Society.[34]

Cardiopulmonary exercise testing is the gold standard measurement of aerobic capacity in patients with PAH, and thus is the best method for assessing physiologic changes associated with exercise training.[37-40] A work rate (WR) 5-20 watts per minute was chosen based on clinical appraisal in an attempt to prevent excessively short or long test durations.[12] Traditional stopping criteria were used.[41] Determination of anaerobic threshold (AT) was based on the ventilatory equivalent method.[12]

Subjects

Subject 1. Subject 1 had been a fit, active 50-year-old male industrial pipe welder who developed progressive dyspnea, ascites, and lower extremity edema while living at high-altitude for 15 years. He was ultimately hospitalized for acute renal and heart failure 13 months prior to study enrollment. Initial work-up revealed a systolic pulmonary

artery pressure (SPAP) estimated to be in the high 60s by echocardiography with a normal left ventricular ejection fraction (LVEF) of 50%. Further work-up was consistent with idiopathic PAH as helical CT scanning, ventilation-perfusion scanning, polysomnography, HIV titer, and ANA excluded other possible causes of pulmonary hypertension. Pulmonary function testing was not performed because it was initially not clear whether this testing was performed at a prior facility that performed the initial diagnosis. Because Subject 1 was uninsured during the majority of his initial work-up, every effort was made to not unnecessarily repeat any prior testing. Right heart catheterization 4 months prior to enrollment revealed a pulmonary artery pressure (PAP) of 93/35 mmHg (mean 54 mmHg). Repeat echocardiography 7 months prior to enrollment demonstrated a normal LVEF an estimated SPAP of 90 mmHg. Daily medications included digoxin (0.125 mg), furosemide (alternating 20 and 40 mg), potassium chloride (alternating 20 and 40 mEq), famotidine (20 mg), levothyroxine (50 mcg), and atenolol (25 mg). Sildenafil citrate (20 mg 3 times daily) was added for managing his PAH within the first 4 weeks of his initial hospital admission.

Subject 2. Subject 2 was a 57-year-old female dialysis nurse with a long (20+ years) history of scleroderma. Additional medical history included celiac disease, a small right kidney, chronic renal insufficiency, possible lymphangioleiomyomatosis, and mild chronic anemia. She was diagnosed with scleroderma-associated PAH 6 years prior to enrollment. Pulmonary function testing during her initial evaluation for PAH revealed evidence of mild obstructive disease (and was subsequently started on advair); however, CPET testing at that time was consistent with a pulmonary vascular limitation to exercise and was without evidence of a ventilatory limit. Her most recent right heart catheterization 3 years prior to enrollment demonstrated a PAP of 63/15 mmHg with a mean PAP of 32 mmHg. Echocardiography 4 months prior to enrollment demonstrated an LVEF of 67% and estimated SPAP of 60-70 mmHg. Daily medications included fluoxetine (60 mg), levothyroxine (75 mcg), digoxin (.125 mg), captopril (12.5 mg), fluticasone/salmeterol (100/150 mcg, twice), lovastatin (40 mg), spironolactone (25 mg), and warfarin. Medications for managing her PAH included sildenafil citrate (60 mg 3 times daily), inhaled iloprost (2.5 mcg, 6 times daily), and ambrisentan (5 mg). Demographics for both subjects are displayed in Table 1.

Table 1. Baseline Characteristics of Subjects

	SUBJECT 1	SUBJECT 2
Age (years)	50	57
Gender	Male	Female
Height (inches)	69	70.5
Weight (lbs)	160	124
Etiology	idiopathic	scleroderma
Years Since Diagnosis	1.25	6
Right Heart Catheterization PAP (mmHg)	93/34	63/15
mPAP (mmHg)	54	32
PCWP (mmHg)	9	1
PVR (Wood Units)	7.7	8
Cardiac Index (lpm/m^2)	3.1	2.8
PAH Medications	sildenafil	sildenafil, ambrisentan, inhaled iloprost
Pulmonary Function Testing Value/Percent Predicted FVC (L)	Not Performed	3.68/96%
FEV_1 (L) Pre-bronchodilation	-	2.73/88%
FEV_1 (L) Post-bronchodilation	-	2.93/95%
FEV_1/FVC (%)	-	74/81
MVV (L/min)	-	110/102%
Residual Volume (L)	-	3.64/171%
Total Lung Capacity (L)	-	7.38/124%
DLCO (mL/min/mmHg)	-	9.54/50%

PAH = pulmonary arterial hypertension, PAP = pulmonary artery pressure, mPAP = mean pulmonary artery pressure, PCWP = pulmonary capillary wedge pressure, PVR = pulmonary vascular resistance, FVC = forced vital capacity, FEV_1 = forced expiratory volume in 1 second, MVV = maximum voluntary ventilation, RV = residual volume, TLC = total lung capacity, DLCO = diffusing capacity of carbon monoxide

Exercise Training Intervention

The intervention consisted of cycle ergometry 3 days per week for 6 weeks conducted by one of the authors (MS). Each session consisted of 5 minutes of warm-up, 35 minutes of loaded cycling, and 5 minutes of cool down. Intensity started at approximately 50% of peak workload as measured using the CPET ramped protocol, and was progressed as tolerated based on rating of perceived exertion (RPE), heart rate (HR), blood pressure (BP), and oxygen saturation (SpO_2), which were monitored every 5 minutes. Training was progressed and training intensity was increased to the highest tolerated workload so long as the following thresholds were not exceeded: RPE >3/10 ("moderate breathlessness" or greater), HR > 80% age-predicted maximum, SBP > 180 mmHg, or SpO_2 <92%. All training sessions were monitored using a single-lead ECG. The screening protocol used to ensure clinical stability prior to each session is outlined in Table 2.

RESULTS

Both subjects attended all 18 exercise training sessions. Neither subject developed any new PAH symptoms, worsening clinical status, or adverse events related to any study procedure. Figure 1 demonstrates the training workload at each of the 18 sessions. Training intensities resulted in 70% to 80% of age-predicted maximum HR and 55% to 70% of initial peak work rate. Neither subject experienced oxygen desaturation on room air. Progression of workload for Subject 2 was limited on sessions 3, 4, 8, 10, 11, 13, 14, and 17 due to a systolic hypertensive response with exercise, and intensity was adjusted to maintain systolic BP under 180 mmHg. Her systolic BP responded immediately to reduced workloads as well as cool-down and rest periods. Changes in 6MWT distances, peak oxygen consumption (VO_2), peak work, AT, work at AT (W_{AT}), CRQ scores, and CAMPHOR scores are presented in Tables 3 and 4.

Table 2. Screening Criteria Prior to Each Session

Vital Signs:

- Resting vital signs as follows:
  Heart Rate: >60, < 110 beats per minute
  Blood Pressure: >90/50 mmHg
  Respiratory Rate: <24 breaths per minute
  SpO2: >92%
- No weight gain >2 lbs over the past 2 days
- No change in baseline LE edema

Questions:

- Has there been a change in or development of orthopnea or paroxysmal nocturnal dyspnea?
- Is there any dyspnea, chest pain, or lightheadedness at rest?
- Has there been a change in or development of new musculoskeletal pain?

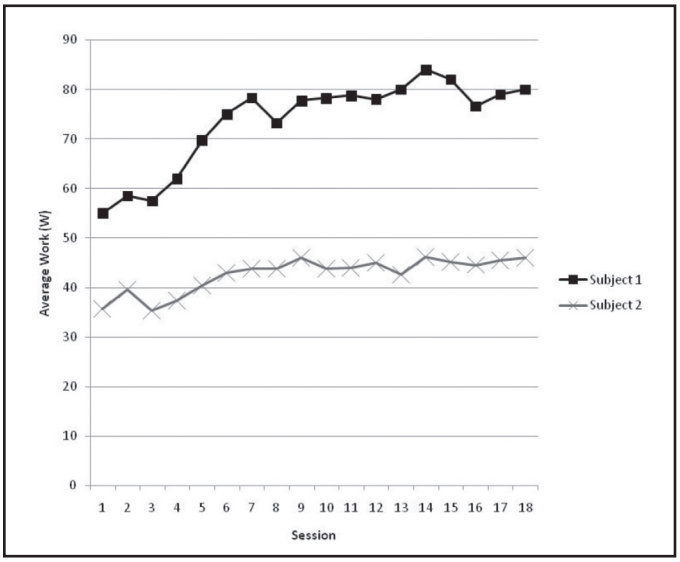

Figure 1. Training workload per session.

Regarding changes in functional status, both subjects rated themselves as NYHA-FC I following training (both were NYHA-FC II at baseline). Regarding changes in functional exercise tolerance, both subjects improved their 6MWT distance (90 and 102 meters, respectively). Several indices from CPET were used to evaluate the effects of exercise training. Subject 1 demonstrated larger improvements in all indices, including peak VO_2 (16.0 to 18.3 $mL \cdot kg^{-1} \cdot min^{-1}$), peak work (117-134 W), AT (10.0 to 13.8 $mL \cdot kg^{-1} \cdot min^{-1}$), and W_{AT} (56 to 82 W). In contrast, Subject 2 demonstrated substantial improvements in AT (9.2 to 13.4 $mL \cdot kg^{-1} \cdot min^{-1}$) and W_{AT} (34 to 52 W) but only demonstrated slight improvements in peak VO_2 (15.0 to 15.6 $mL \cdot kg^{-1} \cdot min^{-1}$) and peak work (66 to 69 W).

Regarding HRQL, both subjects demonstrated improvements on the CRQ, with Subject 1 improving in only the dyspnea (5.33 to 6.33) and emotion (6.29 to 6.85) domains compared to Subject 2 who improved in the dyspnea (5.75 to 6.5), fatigue (3.0 to 4.0), and emotion (4.86 to 5.57) domains. Based on the CAMPHOR, only Subject 2 demon-

Table 3. Cardiopulmonary Exercise Test Changes Following Training

SUBJECT 1	Baseline	Post- Training (% Change)
Peak VO_2 ($mL \cdot kg^{-1} \cdot min^{-1}$)	16	18.3 (+14%)
Peak Work (W)	117	134 (+14.5%)
VO_2 at AT ($mL \cdot kg^{-1} \cdot min^{-1}$)	10	13.8 (+38%)
Work at AT (W)	56	82 (+46%)
Peak RER	1.28	1.27
Maximum Heart Rate	145	145
VE_{max} (L/min)	61.0	70.1
VE/VCO_2 at AT	35.2	34.9
Peak Oxygen Pulse	8.0	9.0
SUBJECT 2	Baseline	Post- Training (% Change)
Peak VO_2 ($mL \cdot kg^{-1} \cdot min^{-1}$)	15.0	15.6 (+4%)
Peak Work (W)	66	69 (+4.5%)
VO_2 at AT ($mL \cdot kg^{-1} \cdot min^{-1}$)	9.2	13.4 (+46%)
Work at AT (W)	34	52 (+53%)
Peak RER	1.40	1.39
Maximum Heart Rate	120	145
VE_{max} (L/min)	50.3	56.0
VE/VCO_2 at AT	33.5	39.1
Peak Oxygen Pulse	7.0	6.0

VO_2=oxygen consumption, AT = anaerobic threshold, RER = respiratory exchange ratio, VE = minute ventilation, VE/VCO_2 = ventilatory equivalent for carbon dioxide

Table 4. Health-Related Quality of Life Changes Following Training

SUBJECT 1	Baseline	Post- Training
CRQ Overall	24.87	26.43
Dyspnea	5.33	6.33
Fatigue	6.5	6.5
Emotion	6.29	6.85
Mastery	6.75	6.75
CAMPHOR Overall	3/65	3/65
Quality of Life	2/25	2/25
Activity	0/15	0/15
Symptoms	1/25	1/25
SUBJECT 2	Baseline	Post- Training
CRQ Overall	20.11	22.82
Dyspnea	5.75	6.5
Fatigue	3.0	4.0
Emotion	4.86	5.57
Mastery	6.5	6.75
CAMPHOR Overall	17/65	3/65
Quality of Life	1/25	0/25
Activity	3/15	0/15
Symptoms	13/25	3/25

CRQ = Chronic Respiratory Disease Questionnaire (higher score is better), CAMPHOR = Cambridge Pulmonary Hypertension Outcome Review (lower is better)

strated improvements which occurred in all domains with an overall improvement of 14 points.

DISCUSSION

We demonstrated that a short and practical outpatient exercise training program can improve measures of workload, aerobic capacity, and HRQL in people with PAH with no adverse effects shown in these two case studies. These outcomes are consistent with those demonstrated by previous studies[29,30] specifically investigating exercise training in patients with PAH. Unlike the study by Uchi et al,[29] these 2 subjects were not receiving intravenous prostacyclin. And, unlike the studies by Uchi et al[29] and Mereles et al,[30] this training protocol involved only a single intervention and did not include an inpatient hospital stay. The improvements demonstrated by our 2 subjects were also consistent with those demonstrated in patients with similar limitations of exercise tolerance such as COPD and CHF.

Regarding functional status as measured by the NYHA-FC, both subjects rated themselves as having improved from Class II to Class I. With regard to submaximal exercise tolerance measured by the 6MWT, both subjects demonstrated substantial improvement in distance walked. Redelmeier et al[42] reported a minimum clinically important difference of 54 meters, however, this was in patients with COPD. O'Keefe et al[43] suggested a minimum clinically important differences of 24 to 47 meters in patients with heart failure, and Guyatt et al[44] found within-subject standard deviation to be approximately 24 meters, suggesting the need to exceed at least 30 meters in determining the significance of change in the 6MWT following an intervention. Mean changes in 6MWT distance in the studies by Uchi et al[29] and Mereles et al[30] specifically evaluating the effect of exercise training in patients with PAH found mean changes of 31 and 96 meters, respectively. We suspect that the improvement of approximately 100 meters in our subjects likely represents a clinically significant change.

Based on CPET, there were notable differences in how the two subjects changed in response to exercise training. Both subjects demonstrated improvements in AT and W_{AT}. However, only Subject 1 substantially improved peak VO_2 and peak work. His improvement of 2.3 $mL \cdot kg^{-1} \cdot min^{-1}$ and 21 W is consistent with the mean changes of 2.2 $mL \cdot kg^{-1} \cdot min^{-1}$ and 20 W found by Mereles et al.[30] It is also consistent with the weighted mean difference of 2.16 $mL \cdot kg^{-1} \cdot min^{-1}$ (95% CI 1.49- 2.82) and 15.13 W (95% CI 12.59-17.67) found in the meta-analysis conducted by Rees et al[45] in a review of the effects of exercise in CHF. Subject 2, however, only demonstrated slight improvements in peak VO_2 and peak work, despite significant improvement in NYHA-FC, 6MWT distance, and HRQL. The reason for this is not readily apparent, but may be due to her long-standing scleroderma. As previously noted, the training intensity in nearly half of the training sessions was not able to be progressed to the same degree as that for Subject 1 due to a hypertensive systolic BP response. The hypertensive response was likely due to her increased peripheral vascular resistance and decreased vascular compliance associated with her scleroderma. Thus, her lack of improvement in maximal exercise capacity may have been a result of reduced training intensity or other consequences of her scleroderma. Individuals with scleroderma-associated PAH and idiopathic PAH both demonstrate elevated pulmonary artery pressures, increased pulmonary vascular resistance, and subsequent reductions in pulmonary perfusion and cardiac output that result in dyspnea, exercise intolerance, inactivity, and deconditioning. However, due to the systemic and chronic nature of scleroderma, these individuals may not demonstrate large improvements from a 6 week training program, and may require a longer training period. Subject 2 had a 20+ year history of systemic scleroderma and a 6 year history of PAH, and had therefore been in a deconditioned state for a much greater period of time compared to Subject 1 whose disease onset and subsequent activity limitation was less than 2 years. Unfortunately, Mereles et al[30] did not report the specific disease etiologies for the included subjects with WHO Group I PAH. Whether patients with idiopathic and scleroderma-associated PAH respond differently to exercise training should be examined in future trials of exercise training in PAH.

Additional differences in gas exchange indices on CPET observed between Subjects 1 and 2 included oxygen pulse and ventilatory equivalent for carbon dioxide (VE/VCO_2 at AT). In contrast to Subject 1, Subject 2, following exercise training, demonstrated a lower peak oxygen pulse (oxygen consumed per beat) and a higher VE/VCO_2 at AT, as well as higher VE/VCO_2 values at equivalent submaximal workloads compared to baseline. These changes in these indices could reflect a worsening of her disease status with regard to cardiac output and lung perfusion. This is somewhat doubtful, however, given the improvement in all other measures, as well as no change in end-tidal carbon dioxide, an indicator of disease severity.[46] The ability of Subject 2 to attain a higher peak HR with exercise is a possible outcome following exercise training, and may explain the lower oxygen pulse as her peak HR on CPET increased 20 beats per minute following exercise training. Despite her improved exercise tolerance and presumed improvement in skeletal muscle aerobic metabolism, her VE/VCO_2 was not lower at equivalent submaximal workloads following exercise training as might be expected. It is not yet known whether consistent improvements in VE/VCO_2 following exercise training in patients with PAH can be observed if disease severity remains unchanged.

Regarding HRQL, both subjects demonstrated clinically significant improvements of greater than 0.5 points[31] in the dyspnea and emotion domains of the CRQ. Unlike Subject 2, Subject 1 did not improve on the fatigue domain or any domain on the CAMPHOR, but this may be due to his relatively minimal limitations in those domains. Subject 2 demonstrated concurrent improvements in both the CRQ and CAMPHOR scores. Minimum clinically important differences of the CAMPHOR have not yet been established.

While the role of exercise training in the comprehensive management of patients with PAH is promising for improving functional exercise tolerance and HRQL, there is much that is not known. Both Uchi et al[29] and Mereles et al[30] documented no change in disease severity based on echocar-

diography and right heart catheterization following exercise training. Routine clinical follow-up for Subjects 1 and 2 at 7 and 5 months, respectively, demonstrated no significant change in echocardiographic measures of disease severity despite maintenance of their improved clinical status. While this is not surprising in light of what is observed in patients with COPD[27] and CHF[47] following sustained, ongoing exercise training, further evidence is needed to demonstrate other important benefits such as reduced hospitalization and reduced outpatient service utilization similar to emerging evidence in the care of individuals with COPD[27] and CHF.[47] Furthermore, it is not yet clear which individuals with PAH might not benefit from exercise training or whether patients with more advanced PAH (based on NYHA-FC) can safely participate in and derive similar benefits from exercise training. The individuals who have participated in exercise training trials in the published literature to date, in addition to the 2 subjects reported here, have been carefully selected and screened, and may not represent the general population of those with PAH.

CONCLUSIONS

This case report presents 2 subjects with WHO Group I PAH who underwent a feasible, short course of exercise training. No adverse events were noted, and both subjects demonstrated improvements in functional status, exercise tolerance, and HRQL. These improvements were similar to those found in individuals with COPD and CHF, as well as 2 previous studies investigating the effect of exercise training in those with PAH. Further research is needed to further demonstrate safety, efficacy, and feasibility of exercise training in patients with PAH, with particular focus on hospitalization and health care utilization.

ACKNOWLEDGEMENTS

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CSM 2010 Platform and Poster Presentation Schedule

Friday February 19, 2009

Session I: 8:00-11:00 am

8:00-8:20 am
Inspiratory Muscle Strength Training Improves Weaning Outcome in Failure to Wean Patients
Martin, Danny; Smith, Barbara K.; Gonzalez-Rothi, Ricardo; Harman, Eloise; Deoghare, Harshavardhan; Huang, Tseng-Tien; Davenport, Paul; Gabrielli, Andrea.

8:20-8:40 am
Are Oxygen Saturation and Heart Rate Correlated with Perceived Fatigue and Dyspnea after the 6 Minute Walk Test in Survivors of Acute Respiratory Distress Syndrome/Acute Lung Injury?
Ciesla, Nancy; Dinglas, Victor; Vatwani, Archana; Barbe, Cynthia; Graham, Meagan; Needham, Dale.

8:40-9:00 am
Further Evidence of the Clinical Utility of the Supine to Stand Test in Heart Failure
Healey, Lauren J.; Knocke, Ann; Dreyer, Hazel; Rubenstein, Joel J.; Cahalin, Lawrence.

9:00-9:20 am
An Alternative Lymphedema Therapy Protocol for a Patient with Lower Extremity Lymphedema and Congestive Heart Failure
Greene, Revenda A.; Fowler, Rhonda B.; Karavatas, Spiridon.

9:20-9:40 am
The Influence of Cardiovascular Risk and Comorbidity on Physical Therapy Outcomes
Scherer, Susan; Bartlett, Rebecca; McMicken, Ashlee; Haugland, Deming; Berkshire, Sarah; Martina, Evan; Reyes, Katherine N.

9:40-10:00 am
A Novel Approach to a Typical Cardiac Rehabilitation Program: For Your Heart, an Exercise DVD
Cleary, Kimberly K.; LaPier, Tanya; Jamison, Ashley; Beadle, Christopher.

10:00-10:20 am
The Relationship between Physical Activity and Physical Function in Individuals Post-bariatric Surgery
Josbeno, Deborah; Jakicic, John; Kalarchian, Melissa; Sparto, Patrick J.; Otto, Amy.

10:20-10:40 am
Lipid and Fitness Profiles of Normal Weight, Overweight and Obese Rural Prehypertensive Women
Hageman, Patricia A.; Pullen, Carol H.; Boeckner, Linda S.; Walker, Susan N.

10:40-11:00 am
Training Adaptations in Women following a Nine Month Employee Wellness Program: A Summative Evaluation Study
Pepin, Marie-Eve; Davis, Amanda; Venglar, Brian; Brown, Todd; Padgett, Mila; Drouin, Jacqueline S.

Session II: 1:00-3:00 pm

1:00-1:20 pm
The Frequency and Use of Patient Simulators in U.S. Physical Therapy Schools
Stockert, Brad; Chevreaux, Laura; Sperry, Cristina; Wooden, Adam.

1:20-1:40 pm
Facilitating Perceived Competency in Clinical Decision Making
Sobush, Dennis C.; Kontney, Laurie; Parker, Danille; Haddenham, Kay; Kletch, Suzanne.

1:40-2:00 pm
Self Reported Frequency and Importance of Measuring Heart Rate and Blood Pressure at Physical Therapy Clinical Sites: A Descriptive Study
Arena, Sara K.

2:00-2:20 pm
Anaerobic Thresholds of Patients after Traumatic Brain Injury: Comparison to Healthy Sedentary Controls
Amonette, William; Mossberg, Kurt A.

2:20-2:40 pm
Reliability of an Armband Energy Expenditure Measurement Device: A Meta-Analysis
Ryde, Amanda M.; Bieniek, Michelle; Drouin, Jacqueline S.; Whittington, Tygre; Gellish, Ron.

2:40-3:00 pm
Agreement of Armband Energy Expenditure Measures to Indirect Calorimetry for Activities of Daily Living: A Reliability Study.
Bieniek, Michelle; Ryde, Amanda M.; Whittington, Tygre; Gellish, Ron; Drouin, Jacqueline S.

POSTER PRESENTATIONS

Poster 1
Cardiovascular Effects and Energy Expenditure in Healthy Normal Children during Horseback Riding: A Pilot Study
Leong, Joanne; Henderson, Roberta; Hunter, Diana; Frownfelter, Donna.

Poster 2
Examination of the Association Between a Child's Health Behavior and the Home Environment and their HR, BMI,

Flexibility and Strength Measures
Gorman, Ira; Birkenstock, Stephanie J.; Lorenzi, Kathleen A.; Price, Grace E.

Poster 3
The Use of Cardiopulmonary Objective Quality of Life Measures in Physical Therapy Practice: A Qualitative Study
Lefebvre, Kristin M.; Keirsey, Aliah; Anderson, Terri; Herbertson, Kim; Wnorowski, Heather.

Poster 4
Comparisons of Cardiovascular Endurance and Physical Activity Between Supervised and Home-Based 8-Week Exercise Training Programs in Individuals with Below-Knee Amputation – A Preliminary Report
Kanelakos, Brian J.; Lin, Suh-Jen; Shakja, Ujjwal.

Poster 5
A Non-traditional Approach to Cardiac Rehabilitation in the Dialysis Center for a Patient with End-stage Renal Disease following Coronary Artery Bypass Surgery: A Case Report
McVey, Lisa W.; Hillegass, Ellen.

Poster 6
Reliability and Validity of the End Tidal CO2 from the Capnotrainer
Coleman, Kim W.; Millar, A Lynn; Boothby, Michelle; Currier, Erin; Eno, Crystal; Monsma, Kelly.

Poster 7
Influence of Activity Levels versus Energy Intake on Percent Excess Weight Loss (%EWL) after Roux-en-Y Gastric Bypass Procedures (RYGBP)
Forbush, Steven W.; Nof, Leah; Echternach, Jack; Hill, Cheryl.

Poster 8
Developing a Clinical Prediction Rule for Screening Adolescent Females for Cardiovascular Disease Risk
Brahler, C. Jayne; Donahoe-Fillmore, Betsy

Poster 9
Changes in BMI and Blood Pressure Following a 10 Week Exercise and Nutrition Program for Children Who Are Overweight or Obese
Martino, Sharon A.; Morelli, Peter J.; Dixon, Denise.

Poster 10
Do Cardiac and Pulmonary Patients Enrolled in a Hospital-Based Rehabilitation Program Demonstrate Clinically Significant Improvements?
Smith, Christine; Brahler, C. Jayne; Glenn, Terri; Anloague, Phil.

Poster 11
Lower Extremity Strength Training Following Acute Lung Transplantation: Preliminary Analysis
Smith, Barbara K.; Franceschi, Amy; Huang, Tseng T.; Deoghare, Harshavardhan; Martin, Daniel.

Poster 12
Physical Function, Age, and Mental Status are Related to Physical Activity and Exercise Self-Efficacy 3, 6, and 12 months Following Coronary Artery Bypass Surgery
LaPier, Tanya; Cleary, Kimberly K.; Gefroh, Jesse; Graham, Ruthe; Hedgecock, Katlynn.

Poster 13
Iyengar Yoga vs. Enhanced Usual Care on Blood Pressure in Patients with Prehypertension to Stage I Hypertension: A Randomized Controlled Trial
Galantino, Mary Lou; Cohen, Debbie; Bloeden, Lee Ann; Rothman, R.; Farrar, John T; Volger, S.; Mayor, S.; Szapary, Phillipe; Townsend, Raymond.

Poster 14
Effects of an Intensive Task-Specific Rehabilitation Program on Cardiovascular Efficiency in Individuals With Chronic Stroke
Fruth, Stacie J.; Combs, Stephanie; Harmon, Jennifer A.; Downs, Anne M.

Poster 15
The Effects of Levodopa on Norepinephrine and Cardiovascular Responses During Maximal Exercise in Parkinson's Disease
DiFrancisco-Donoghue, Joanne; Lamberg, Eric M.; Bono, Nancy; Elokda, Ahmed; Werner, William G.

Poster 16
Exercise Training Adaptations in Women with Very Low Initial Aerobic Capacity Levels: A Comparison Study
Pepin, Marie-Eve; Venglar, Brian; Brown, Todd; Davis, Amanda; Padgett, Mila; Drouin, Jacqueline S.

Poster 17
Exercise Training Adaptations in Middle Aged Women Participating in a Worksite Wellness Program: A Cohort Comparison Study
Davis, Amanda; Pepin, Marie-Eve; Brown, Todd; Venglar, Brian; Padgett, Mila; Drouin, Jacqueline S.

Poster 18
The Effect of Body Position on Maximum Inspiratory and Expiratory Pressures and Forced Expiratory Flow
Nichols, Travis; Osborn, Amy; Tindall, Kelly; Hiebert, Jean M.

Poster 19
Endotracheal Suctioning and Saline Instillation: A Systematic Review of the Literature
Lowman, John D.; Green, Courtney; Joseph, Darren; Weeks, Aaron.

Poster 20
Blood Lactate Response during Maximal Exercise in Parkinson's Disease On and Off Medication
DiFrancisco-Donoghue, Joanne; Lamberg, Eric M.; Werner, William G.

Poster 21
Physiological Effects of Nordic Walking versus Regular Fast Walking on Healthy Adults: A Pilot Study
Henderson, Roberta J.; Gronner, Kristin; Laughlin, Michelle; O'Brien, Nicole; Pacquette, Kristy; York, Jennifer.

Poster 22
Cardiovascular Responses to Different Times of Walk using Standard Walker and/or Platform Walker with wheels in Non Weight Bearing Individuals
Adah, Felix; Greenwald, Neva F.; Kuebler, Joy C.; Pearson, Becca.

Platform Presentations

INSPIRATORY MUSCLE STRENGTH TRAINING IMPROVES WEANING OUTCOME IN FAILURE TO WEAN PATIENTS. *[1]Martin, Danny; [1]Smith, Barbara K.; [3]Gonzalez-Rothi, Ricardo; [3]Harman, Eloise; [1]Deoghare, Harshavardhan; [1]Huang, Tseng-Tien; [4]Davenport, Paul; [2]Gabrielli, Andrea. [1]Physical Therapy, University of Florida, Gainesville, FL; [2]Anesthesiology/Critical Care, University of Florida, Gainesville, FL; [3]Medicine/Pulmonary & Critical Care, University of Florida, Gainesville, FL; [4]Physiological Sciences, University of Florida, Gainesville, FL, USA.*

Purpose/Hypothesis: Failure to wean (FTW) from mechanical ventilation (MV) is a major clinical and economic problem. Numerous animal studies and limited human data have shown that MV use rapidly leads to ventilator induced diaphragm dysfunction, which includes diaphragm atrophy and weakness and is a likely contributor to FTW. Several uncontrolled trials examining the effect of specific inspiratory muscle strength training (IMST) on weaning outcome exist, but no controlled trials have been conducted. We tested whether IMST would improve weaning outcome in FTW patients in a controlled trial. **Number of Subjects:** 35 subjects were randomly assigned to the IMST condition and 34 to a SHAM treatment. **Materials/Methods:** Patients were recruited from the medical and surgical ICUs of an academic health center, and informed consent was obtained. All subjects had failed to wean with usual medical care. IMST was performed with a threshold inspiratory device, set at the highest inspiratory pressure tolerated. The SHAM device was a modified Pflex resistive inspiratory training device that provided a low (-2 to -3 cm H2O) inspiratory pressure load. Both groups completed 4 sets of 6-10 training breaths, 5 days per week. All subjects performed progressively longer unsupported breathing trials daily per protocol. The weaning criterion was 72 consecutive hours without ventilator support. Subjects were blinded to group assignment, and were treated until weaned or 28 days. **Results:** Groups were similar in age, gender, cause of respiratory failure, amount of MV support required, arterial blood gases, PaO2/FiO2 ratio, dynamic lung compliance, lung resistance, prealbumin, smoking history and SAPS II score upon starting treatment. 43% of IMST subjects required renal replacement therapy, compared to 29% of SHAM subjects, p=.24. The IMST and SHAM groups respectively received 40±25 vs 46±32 days of MV support prior to starting intervention, p =.39. The IMST group's training pressure increased from -7.2±2.6. cm H2O pre-training to - 12.3±3.6 at post-training, p < .0001. The IMST group improved maximal inspiratory pressure (MIP) from -44±19 cm H2O pretraining to -55±18 post-training, while the corresponding values for the SHAM group were -43±18 cm H2O and -45±20. The MIP change between groups was significant, p < .001. The IMST and SHAM groups were treated for 15±8 and 18±9 days respectively, p =.13. 25 of 35 (71%) IMST subjects weaned, while 16 of 34 (47%) SHAM subjects weaned, p = .04. The number of patients needed to be treated with IMST to prevent a single weaning failure with the SHAM condition was 4. **Conclusions:** The results show that an IMST rehabilitation program can rapidly increase MIP and lead to an improved weaning outcome in FTW patients compared to usual care. **Clinical Relevance:** This is the first controlled trial examining the effect of an IMST rehabilitation program on weaning outcome in FTW patients and demonstrates a practical, strong treatment effect in this difficult patient population. Funded by NIH RO1 HD042705 to DM

ARE OXYGEN SATURATION AND HEART RATE CORRELATED WITH PERCEIVED FATIGUE AND DYSPNEA AFTER THE 6 MINUTE WALK TEST IN SURVIVORS OF ACUTE RESPIRATORY DISTRESS SYNDROME/ACUTE LUNG INJURY?
[1]Ciesla, Nancy; [2]Dinglas, Victor; [1]Vatwani, Archana; [1]Barbe, Cynthia; [1]Graham, Meagan; [2]Needham, Dale. [1]Physical Medicine and Rehabilitation, Johns Hopkins Hospital, Baltimore, MD; [2]Division of Pulmonary and Critical Care Medicine, Johns Hopkins University, Baltimore, MD, USA.

Purpose/Hypothesis To determine the correlation between perceived fatigue (FATG) and dyspnea (DYSP) utilizing the Borg Criterion Ratio-10 (CR-10) with heart rate (HR) and oxygen saturation (SpO2) in survivors of acute lung injury (ALI) undergoing a 6 minute walk test (6MWT). **Number of Subjects:** This report is part of an ongoing multi-site, prospective cohort study of long-term outcomes after ALI (NIH Grant # P50 HL073994). Participants were initially mechanically ventilated and consented to 6MWT at 3 months after ALI diagnosis. Eligibility criteria included an exclusion for patients with a life expectancy <6 months due to pre-existing disease. The 6MWT was completed by 99 patients (54% male, median age 47) with 98 HR and 78 SpO2 measurements available. **Materials/Methods:** Patient's HR, SpO2 and Borg CR-10 for FATG and DYSP were recorded at the beginning and end of the 6MWT. Correlations between HR and Sp02 versus Borg scores were calculated. Paired and independent z tests based on the Fisher z-transformation were used for comparing the dependent and independent correlation coefficients (CC). **Results:** We compared the correlations of HR and SpO2 versus FATG and DYSP using: (1) measures obtained after completing 6MWT, and (2) the change in measures from

post-6MWT minus pre-6MWT. (1) Measures after 6MWT* HR vs. FATG: r=0.12; HR vs. DYSP: r=0.20 (p=0.15); SpO2 vs. FATG: r=-0.18; SpO2 vs. DYSP: r=-0.29 (p=0.11). (2) Change in measures pre-and post-6MWT* HR vs. FATG: r= 0.04; HR vs. DYSP: r= 0.10(p=0.28) SpO2 vs. FATG r=-0.03; SpO2 vs. DYSP r=-0.14 (p=0.15) *The p-values are for comparison of the 2 CC in each row. Comparisons of each matching CC in (1) versus (2) had p>0.32. **Conclusions:** 1.The correlations between the Borg CR-10 scales for DYSP and FATG versus HR and SpO2 physiological measurements are non-significantly greater when comparing the values after 6MWT rather than the change in these values between the start and end of 6MWT. 2. The Borg DYSP (vs. FATG) scale had a non-significantly stronger correlation with HR and SpO2. 3. The correlations of Borg DYSP and FATG scales with HR and Sp02 are not strong. The 6MWT may not provide an adequate exercise (EX) stimulus, or the Borg scale may not closely reflect these physiological measures after ALI. Multiple factors aside from HR and Sp02 may underlie these patients' perceived DYSP and FATG. 4. Larger studies are needed to confirm these conclusions and to investigate the factors associated with patient DYSP and FATG after exercise. **Clinical Relevance** Perceived exertion has been described as the single best indicator of physical strain. With improving ICU mortality for ALI, a growing number of survivors require physical therapy. Physical therapists frequently prescribe walking programs using the CR-10 scale. Although this scale is widely used based upon high correlations with HR in small studies of <20 normal subjects who cycled and performed arm EX, this larger-sized study demonstrated that HR and SpO2 may be better indicators for prescribing low intensity EX, such as a walking program, in patients recovering from ALI.

FURTHER EVIDENCE OF THE CLINICAL UTILITY OF THE SUPINE TO STAND TEST IN HEART FAILURE.

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Purpose/Hypothesis: The cardiovascular response (CVR) to orthostatic stress (OS) has been extensively examined in health and disease, but its clinical utility in congestive heart failure (CHF) has not been fully appreciated. The CVR to OS in patients with CHF has been observed to be different from that in persons without CHF. In fact, patients with CHF have been observed to have increased tolerance to OS and demonstrate a decrease, rather than the normal increase, in diastolic blood pressure upon standing. We hypothesized that patients with stable CHF will have a CVR to OS which will be different than that of patients who have a diagnosis of coronary disease without CHF, and that of a control group. **Number of Subjects:** The CHF group (N=39) consisted of patients with stable CHF (59% men, mean age 76.5) and the cardiac rehabilitation group (CRP) contained 39 patients with cardiovascular disease, but without CHF (72% men, mean age 66). The control group (N=20) consisted of healthy age-matched subjects (45% men, mean age 66.6) without known cardiac disease and not taking anti-hypertensive medications. **Materials/Methods:** A prospective study using a convenience sample of CHF and CRP patients at a community hospital. Each subject performed 2 supine to stand trials. The first trial was preceded by a 5-minute supine rest, and the second trial was preceded by a 15-minute supine rest. The CVR was obtained with a Propaq monitor (Welch Allyn Inc, NY) and included heart rate (HR); systolic, diastolic, and mean arterial blood pressure (SBP, DBP, and MAP, respectively); ECG rhythm; and symptoms within one minute of standing. B-natriuretic peptide (BNP) was measured prior to OS testing. Statistical analyses included calculation of means and standard deviations, one-way and repeated measures ANOVA, and correlation analyses. **Results:** The mean age of the patients in the CHF group was significantly greater ($p<.05$) than that of the other groups. The change in the CVR from supine to standing during Trial 2 was significantly less than in Trial 1. A significant decrease in DBP and MAP was observed in the CHF group ($p<.05$). The change in HR was not significantly different among groups and no significant medication effect upon CVR was observed. Significant correlations were observed between change in DBP and BNP ($r=.64$, $p=.002$), and change in MAP and BNP ($r=.54$, $p=.01$). **Conclusions:** Patients with CHF were observed to have a significantly lower DBP during OS than patients without CHF and control subjects. The 15-minute supine rest period of Trial 2 was associated with less hemodynamic change than the 5-minute rest period of Trial 1. The significant correlations of BNP to CVR identify the potential role of examining the CVR to OS in patients with CHF. **Clinical Relevance:** The CVR to OS appears to be useful in distinguishing patients with CHF from individuals without CHF. Medications were not observed to significantly affect the CVR response enabling patients to continue their medical regimen during such testing. The CVR response of patients with CHF to OS is related to BNP levels and requires further investigation.

AN ALTERNATIVE LYMPHEDEMA THERAPY PROTOCOL FOR A PATIENT WITH LOWER EXTREMITY LYMPHEDEMA AND CONGESTIVE HEART FAILURE.

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Background & Purpose: Lymphedema is a chronic condition characterized by the abnormal accumulation of interstitial fluid, due to insufficiency of the lymphatic system. The most common physical therapy interventions for lymphedema include a combination of skin care, isotonic exercise, manual lymph drainage, compression bandaging and intermittent compression therapy. Intermittent compression therapy is a valuable tool for the reduction and maintenance of lymphedema. However, use of that modality has several contraindications, among them congestive heart failure (CHF). The purpose of this case report is to illustrate the role of an alternative treatment protocol, without intermittent

compression therapy, in decreasing the (R) lower extremity (LE) circumference of a patient with lymphedema and CHF. **Case Description:** The patient was a 70 year old male, who had a quintuple coronary artery bypass graft approximately two years prior to physical therapy intervention. Subsequent to that surgery, he was diagnosed with CHF. Additionally the saphenous vein graft site in the (R) LE became infected. The patient developed venous insuffiency, which progressed to lymphedema in the (R) LE. At the time of the physical therapy examination, the patient was diagnosed with Stage II lymphedema in the (R) LE. The circumference of the (R) LE was a total of 91 cm greater than that of the (L) LE. The patient used a straight cane for ambulation, and his gait was characterized by a wide base of support with a lateral shift. The patient was seen as an outpatient for physical therapy, 3 x week for 7 weeks. The use of intermittent compression therapy was contraindicated due to the CHF comorbidity. The physical therapy interventions included skin care, manual lymph drainage, therapeutic exercise, compression bandaging, and patient/family education for lymphedema precautions, compression bandaging and a home exercise program. **Outcomes:** After seven weeks of therapy, the patient achieved an reduction in (R) LE circumference of 90.5 cm, thus making the total circumference of both LEs almost identical. His gait was normal, and he no longer required a cane for ambulation. This outcome represented an optimal reduction of lymphedema. The patient was able to maintain the reduction via the use of self bandaging, compression garments and a home exercise program. The patient was pleased with the outcome, and reported that he was able to perform all functional activities without difficulty. **Discussion:** The described intervention served the needs of this patient by promoting a significant reduction of the (R) LE edema. The functional recovery course of this patient was parallel to the ones outlined in the literature. This report is of descriptive nature, and the information provided is experiential. The intent of this case report is to provide fellow clinicians with an alternative lymphedema intervention in cases where the use of intermittent compression therapy is contraindicated.

THE INFLUENCE OF CARDIOVASCULAR RISK AND COMORBIDITY ON PHYSICAL THERAPY OUTCOMES.

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Purpose/Hypothesis: Physical therapists routinely treat patients with comorbid medical conditions as part of a plan of care to improve physical function and quality of life. Exercise increases the risk of cardiovascular events in patients with risk of cardiovascular disease, however cardiovascular risk status is not routinely performed as part of an initial screening. Few studies have examined the effect of comorbidities and cardiovascular risk status on functional outcomes in physical therapy practice. The objective of this study is to examine the influence of comorbid conditions on physical therapy specific outcomes and the association of cardiovascular risk stratification on successful versus non-successful outcomes. **Number of Subjects:** 244 clinical cases were analyzed. **Materials/Methods:** This is a retrospective analysis of the influence of comorbid conditions and cardiovascular risk status on physical therapy specific outcomes. Regis University physical therapy students while on clinical rotations from 2006 to 2009 collected data on routine physical therapy care using outcome measures for 5 different body regions. Patients were assigned to one of three cardiovascular risk strata identified by the American College of Sports Medicine (ACSM) based on the presence of comorbid risk factors. Physical therapy outcomes were defined as success if the minimal clinically important difference (MCID) was achieved on the outcome measure used for the body region treated. Outcomes were coded for success or no success based on the MCID achieved. The Chi-square statistical test was used to analyze differences in patient characteristics across the 5 body region groups. A logistic regression statistical analysis was used to examine whether cardiovascular risk status could predict success vs. no success. **Results:** The mean age of the subjects was 43.27 years (SD±18 years). Of the subjects, 43.8% were classified into the low cardiovascular risk strata, 37.50% in the moderate risk strata and 18.8 % into the high-risk strata. There was no difference between the body region groups in any characteristic except physical activity, ($p = 0.006$). There was no statistical relationship between ACSM risk classification and success/no success. Also, no statistical significance was found between the length of treatment time and success/no success. **Conclusions:** In younger adults patients with predominantly low cardiovascular risk, cardiovascular risk status was not associated with poor success in physical therapy outcomes. **Clinical Relevance:** Cardiovascular risk stratification by students and clinicians in the physical therapy setting is feasible. The majority of patients seen by students were in a low cardiovascular risk category, which may not accurately represent physical therapy practice. Larger sample sizes and alternative methods of classifying successful physical therapy outcomes are suggested for future analysis. Further investigation is also needed as to whether cardiovascular risk status changes the process of delivery of care rather than outcomes.

A NOVEL APPROACH TO A TYPICAL CARDIAC REHABILITATION PROGRAM: FOR YOUR HEART, AN EXERCISE DVD.

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Purpose: Participation in a cardiovascular exercise program is a key intervention for facilitating secondary prevention of cardiovascular disease (CVD). Although exercise is a powerful intervention, many barriers exist for patients to adopt and maintain exercise. Due to factors such as financial constraints, limited accessibility, and lack of physician referral, fewer than half of all patients who are eligible for outpatient cardiac rehabilitation (CR) programs actually

enroll after being discharged from acute care hospitals. Therefore, the inpatient hospital stay may be the only opportunity to provide education and exercise prescription to many patients with CVD. Due to factors such as shorter lengths of stay, effective and efficient methods of providing health education to hospitalized patients are essential. The purpose of this project was to create a comprehensive exercise program to allow patients to exercise safely in lieu of or in addition to participation in a formal CR program. **Description:** The For Your Heart Exercise DVD was created as a resource for patients with CVD to begin or continue exercising following hospital discharge. Media format and user preferences were determined based on results from a previous study on availability of and confidence using technology within this patient population. Based on those results, a digital video disc (DVD) program format was determined to be the most feasible. For Your Heart is divided into three main sections: Before You Begin, Stretch and Strengthen, and Aerobic Workout. The Before You Begin section provides an overview of how to use the DVD, and includes safety considerations before beginning exercise, signs and symptoms to report to the physician, what to do in an emergency, and safe exercise progression. The Stretch and Strengthen section provides three different levels of difficulty: beginner, intermediate, and advanced, with suggestions of where to start based on prior level of activity, medical diagnosis, and whether return to full activity without restrictions has been allowed. The Aerobic Workout section is comprised of five segments: warm-up, workout segments 1, 2 and 3, and cool-down. Sections can be used in different combinations to alter the length and/or variety of the aerobic workout, ranging from 10 to 45 minutes as the participant's endurance and tolerance for exercise improves. The aerobic workout also provides three options for the level of intensity by following specific participants identified by shirt color on the DVD. **Summary of Use:** The For Your Heart Exercise DVD will be distributed locally to patients hospitalized for CVD or participating in local outpatient cardiac rehabilitation programs. Local distribution will include product pilot testing, which will ideally lead to distribution on a national level. **Importance to Members:** For Your Heart will be a useful resource for physical therapists and patients with CVD to facilitate the development of exercise self-management skills and the transition to maintaining independent, lifelong exercise behaviors.

THE RELATIONSHIP BETWEEN PHYSICAL ACTIVITY AND PHYSICAL FUNCTION IN INDIVIDUALS POST-BARIATRIC SURGERY.

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Purpose/Hypothesis: This study characterizes the physical activity profile and physical function of subjects 2-5 years post bariatric surgery. Additionally, this study examines the association between physical activity, physical function and weight loss after bariatric surgery. **Number of Subjects:** Participants included 37 adults (34 female and 3 male) with a mean age of 50.8 ±1.0 years. All subjects were 2-5 years post bariatric surgery. **Materials/Methods:** Physical activity was assessed with an activity monitor (SenseWear® Armband) worn for 7 consecutive days. Physical function was assessed using the physical function subscale of the Medical Outcome Short Form-36 (SF-36PF). Standardized measures of height and weight were obtained on all subjects. **Results:** %EWL was 62.2 ±19.9. Objectively measured physical activity was 205.3 ±136.9 min/wk when activity was defined as ≥3METs/min for bouts ≥1 min in duration. When physical activity was defined as ≥3 METs/min for a duration of ≥10 minutes, the mean was 47.6 ± 69.8 min/wk. The physical function mean score was 85.3 ± 23.9 on SF- 36PF. %EWL was significantly associated with physical activity (r=0.47, p<0.01) and physical function (r=0.35, p=0.03). However, physical activity was not significantly associated with physical function (r=0.20, p=0.24). **Conclusions:** The magnitude of excess weight loss after bariatric surgery is related to higher levels of physical function and greater physical activity. The high physical function scores suggest that subjects are capable of performing most mobility activities. However, the lack of an association between physical function and physical activity may suggest that a higher level of physical function does not necessarily correspond to a higher level of physical activity participation in this patient population. Thus, further research is needed to understand the relationship between physical activity and physical function as it relates to surgical weight loss. **Clinical Relevance:** The lack of an association between physical activity and physical function suggests that barriers to the adoption of a more physically active lifestyle may not be fully explained by the subjects' physical limitations. Thus, more work is needed to design interventions which are specifically targeted at increasing physical activity participation in this population.

LIPID AND FITNESS PROFILES OF NORMAL WEIGHT, OVERWEIGHT AND OBESE RURAL PREHYPERTENSIVE WOMEN.

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Purpose/Hypothesis: The purpose of this study was to determine the differences in lipid profiles and fitness levels among normal weight (BMI<25 kg/m2), overweight (BMI=25-29.9 kg/m2)and obese (BMI≥30 kg/m2) midlife and older prehypertensive rural women. The literature suggests that women are unaware the threat to health that prehypertension may pose. We were interested in whether there were differences in markers of cardiovascular risk, both lipids and fitness, related to categories of body mass index as peri- and post-menopausal women are vulnerable to weight gain. **Number of Subjects:** Baseline data was analyzed from

a convenience sample of 289 prehypertensive (BP 120-139 mmHg Systolic or 80-89 mmHg Diastolic) rural women ages 40-69 who were enrolled in a clinical trial that focused on lifestyle changes of healthy eating and activity to reduce blood pressure. The women were predominately white (99%), aged 55.9±6.4 yrs, 83% married, 79% employed either full- or part-time, and 49% had a family income of $20,000- 59,000 with 44% having a family income of $60,000+. The majority of women were overweight (n=110;38%) or obese (n=125;43%). **Materials/Methods:** Women completed an extensive screening to confirm they met the strict inclusion criteria to participate in this study. There were numerous exclusion criteria and women were excluded if they were taking antihypertensive medication, diuretics or cortisone. Upon providing informed consent, baseline blood pressure was recorded as the average of 4 measures taken during 2 separate visits one week apart following the JNC 7 guidelines. Height and weight were measured for calculation of body mass index. Following appropriate fasting guidelines, blood samples were taken and analyzed for serum lipids (total cholesterol, HDL & LDL, and triglycerides). As an indicator of fitness, resting heart rate was measured following 5 minutes of quiet sitting. The 1-mile walk test was used to estimate VO2max based upon the woman's age, walking time, and 15-second heart rate upon completion of the walk. **Results:** Two separate MANOVAS with Bonferroni correction were conducted for lipid and fitness measures. Group differences were found for 2 serum lipids ($F=7.76$, $p<.001$) and for 1 fitness measure ($F=3.01$, $p<.001$). Post-hoc analyses revealed differences between all 3 BMI groups for triglycerides and estimated VO2max, and between normal and obese women for HDL cholesterol. **Conclusions:** Triglycerides, HDL cholesterol, and estimated VO2max differed significantly across BMI categories, with the healthiest values noted among women in the normal weight category. **Clinical Relevance:** While prehypertension was found among women in all 3 BMI categories, women classified as obese had lipid and fitness measures that were considered high risk for cardiovascular disease. Blood pressure screening and health promotion counseling for obesity and fitness appears warranted for peri- and post-menopausal women as part of regular clinician practice. Funded by NIH NINR 2 RO1 NR04861.

TRAINING ADAPTATIONS IN WOMEN FOLLOWING A NINE MONTH EMPLOYEE WELLNESS PROGRAM: A SUMMATIVE EVALUATION STUDY.

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Purpose/Hypothesis: Physical therapists were invited to critically appraise the effectiveness of a nine month voluntary worksite wellness program through evaluation of changes in participants' physiologic, anthropometric, and serum measures and qualitative information from the program director and staff. **Number of Subjects:** Following institutional board approval, 68 female employees (age 47.0 ± 9.9 years) signed informed consent and voluntarily participated in a University based worksite wellness program. **Materials/Methods:** The study design was a summative evaluation of pre and post test data and qualitative information from the wellness program director and staff. Subjects participated in a worksite program consisting of health promotion and wellness education, nutrition counseling, exercise training guidelines, and stress management opportunities. Participants had regular contact with health and wellness mentors for information, motivation and support. Prior to and following the nine month program, exercise science graduate students performed the physiologic and anthropometric measures, and two certified medical technicians at the University's Health Center performed blood draws and serum analysis. Statistical analysis using the Wilcoxon Sign Rank test examined differences between pre to post test measures with $p \leq .05$. **Results:** 54 women (46.87 ± 10.37 yrs) completed the program. The primary reason given by women who left the program was lack of time. Modest but significant improvements were found following participation for resting heart rate ($p<0.001$), systolic ($p=0.003$) and diastolic ($p=.017$) blood pressure, body mass index ($p<0.001$) and weight ($p<0.001$). No clinically or statistically significant improvements were found for aerobic fitness measures or serum measures such as cholesterol profiles, triglycerides, glucose levels or C-reactive proteins. Qualitative assessment suggested that program limitations included ineffective tracking of participatory attendance, individualized program choices leading to inconsistent training adaptations, and possible measurement errors from predictive level fitness tests. **Conclusions:** Study results suggest that the worksite program had positive effects on some measures of health and wellness for most participants. Summative evaluation revealed program improvements were required for tracking participatory attendance and intensity of training, for using standardized exercise tests and measures to reduce potential measurement errors, for consistent education on effective training parameters, and enhancing motivation to promote participation. **Clinical Relevance:** Data from this study suggests that onsite voluntary worksite programs are beneficial for promoting health and wellness in female employees; however, providing consistent exercise training guidelines and tracking participatory attendance including exercise duration and intensity are recommended to promote further improvements in employee health and wellness outcomes.

THE FREQUENCY AND USE OF PATIENT SIMULATORS IN U.S. PHYSICAL THERAPY SCHOOLS.

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Purpose/Hypothesis: A recent study at Wake Forest Medical Center demonstrated that Physical Therapy (PT) reduced the length of patients' hospital stay. Unfortunately there is a world wide shortage of physical therapists willing to work in acute/intensive care settings. Roskell showed that

the reasons physical therapists give for not working in these settings include: 1) fear-avoidance due to the high patient mortality rate; 2) dissatisfaction with professional skills related to working in this setting; and 3) dissatisfaction with professional skills related to responding to a medical emergency. Patient simulators come in many forms including life size mannequins connected to a computer and other electronic equipment that give the simulators the capacity to talk, have breath sounds, heart tones, etc. Simulation allows an instructor to recreate patient situations and emergencies that occur in acute/intensive care settings without compromising patient safety. The purpose of this study was to determine how many PT schools in the U.S. are currently using patient simulators and examine the manner in which they are being used.**Number of Subjects:** We contacted the 210 CAPTE accredited PT schools in the U.S. listed on the APTA website. **Materials/Methods:** We developed a 10 question survey regarding the use of patient simulators in PT schools. The survey was posted on the internet using "Flashlight" software. We contacted each school with an email that included a unique password and link to the survey. Schools that did not respond to the initial request for participation were sent a follow-up email request about 1 month later. **Results:** We received completed surveys from 140 PT schools (67% response rate). Sixty-one (43.7%) of the respondents reported using patient simulators. Forty-eight (79.0%) of the schools using simulators had a MD &/or RN program that utilized simulators. Of the PT schools that did not use simulators only 61.3% had a MD &/or RN program that used simulators. Simulators were used to train PT students to: take vital signs (35.5%); perform a cardiopulmonary exam (79.0%); perform an examination in an acute/intensive care setting (58.1%); &/or respond to a life-threatening medical emergency (46.8%). **Conclusions:** The results of this study demonstrate that the use of patient simulators is a common occurrence in PT schools in the U.S. Simulators are used most frequently for performing a cardiopulmonary exam but they are also being used to a significant degree to simulate acute/intensive care settings and life-threatening medical emergencies. **Clinical Relevance:** Most PT students never witness nor participate in recognizing and responding to a medical emergency during their clinical affiliations. As a result the first time most physical therapists witness a medical emergency is after they have completed their entry level training. We believe that we can use patient simulators in a safe environment that increases the skills and confidence of PT students/clinicians for work in acute/intensive care settings and for recognizing and responding to medical emergencies.

FACILITATING PERCEIVED COMPETENCE IN CLINICAL DECISION-MAKING.

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Purpose/Hypothesis: This project's purpose was to determine if a unique teaching method would improve student perceptions of competence in clinical decision-making. **Number of Subjects:** DPT students (n=58) in their final academic semester gave their informed consent to participate as part of a Cardiovascular and Pulmonary Physical Therapy course. **Materials/Methods:** Student were included if s/he completed: a baseline (week 3) and follow-up (week 12)rating of perceived level of competency according to 8 criterion, Clinical Reasoning being one, from the Physical Therapist Clinical Performance Instrument (PTCPI); a practice assignment during week 1; and, 5 subsequent worksheets. A deck of cards was modified to contain 5 suits, one for each of the 4 Preferred Practice Patterns (i.e. Hearts, Diamonds, Clubs, and Spades for Cardiovascular/Pulmonary, Integumentary, Neuromuscular, and Musculoskeletal, respectively) and a 5th equating to a personality/culture attribute. Within each suit (ex. Hearts) the severity of a comorbid condition decreases as the face value of the card increases (i.e. two of hearts - Heart Failure and Claudication as compared to Ace of hearts - no risk for CAD, CVA, or DM). One card from each suit is dealt to create a patient scenario. A predetermined physical therapy referral (i.e. "Evaluate & Treat") in an Acute Care practice setting was specified. The patient scenario was then examined and evaluated with a decision required to be made (ex. whether or not to treat).More cards (from 7 to 15)were dealt during subsequent weeks to increase the complexity of the patient profile. After a 20-minute discussion session, students turned in an assignment that addressed the following: 1) How did the cards dealt influence or alter each other? 2) How did each of the cards impact your physical therapy Examination and Evaluation? and, 3) How did the hand you were dealt alter your physical therapy Plan of Care? **Results:** At the baseline PTCPI assessment, 6 students (10.3%) rated themselves at or above entry-level competence as compared to 19 (32.8%) below in all 8 criterion. At follow-up, a percentage improvement in ratings at or above entry-level competence occurred in all 8 criterion (i.e. Evaluation (15.5%); Screening (17.2%); Plan of Care/Clinical Reasoning/Examination (19.0% for each); Procedural Interventions (22.4%); Cultural Competence (51.7%); and Safety (53.4%). Percentage increases in perceived competence occurred as follows: Plan of Care (46.5%), Safety (50%), Cultural Competence & Evaluation each (51.7%), Procedural Interventions (60.3%), Examination (63.8%), Screening (67.2%), and Clinical Reasoning (70.7%). **Conclusions:** This teaching method contributed to positive changes in student perceptions of competence in all 8 PTCPI criterion studied, especially in Clinical Reasoning. **Clinical Relevance:** A higher level of perceived competence is critical to success during DPT internships. This innovative teaching strategy challenges the physical therapy student to make appropriate clinical decisions within the context of the Guide for Physical Therapist Practice.

SELF REPORTED FREQUENCY AND IMPORTANCE OF MEASURING HEART RATE AND BLOOD PRESSURE AT PHYSI-

CAL THERAPY CLINICAL SITES: A DESCRIPTIVE STUDY.

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Purpose/Hypothesis: Cardiovascular disease is responsible for nearly two in five deaths in the United States. The impact this has on American health requires healthcare providers of varied backgrounds to screen and evaluate cardiac measures including heart rate (HR) and blood pressure (BP). The Guide to Physical Therapy Practice states a physical therapist (PT) is to perform a systems review, including HR and BP. The purposes of this study was to 1) assess clinical site instructors (CI's) and Doctorate of Physical Therapy (DPT) students current practice of assessing HR and BP in a variety of practice settings, and 2) to determine if there are correlations between the types of practice settings and assessment of HR and BP. **Number of Subjects:** A sample was recruited from 150 CI's affiliated with one university's physical therapy program, and 28 DPT students from the same university cohort. Total survey return rate was 43% (N=18 students, N=58 CIs). **Materials/Methods:** An 11-item survey and informed consent was obtained by subjects through mailings. Although reliability of the survey was not confirmed, content and face validity were reviewed. Survey questions asked respondent to categorize the frequency, perceived importance and reasons for omission of HR and BP assessment. **Results:** The results of this study showed that CI's in an outpatient setting never or seldom check HR (72%), compared to students in the same practice setting who never and seldom check HR (82%). CI's in an acute care with rehab setting responded to always and about half the time checking HR (67%), compared to students who responded to always and about half the time to checking HR (100%). CI's in an outpatient setting never and seldom check BP (85%), compared to students in outpatient settings who never and seldom (92%) check BP. CI's in an acute care with rehab setting responded they always or about half the time check BP (33%) compared with students who responded 67%. When asked if measuring HR and BP was important, 87% of students and 37% of CI's responded yes. Not required, checked by others, and lack of time were stated reasons for HR and BP omission. **Conclusions:** Students were more inclined than CI's to believe that checking HR and BP was important. In an outpatient setting only 6% of CI's always assess HR and BP, compared to an acute care with rehab setting where 33% of CI's and students equally reported always assessing HR and BP. Limitations to this study include survey reliability and type I and II errors. **Clinical Relevance:** National emphasis on the prevention of cardiovascular disease and its risk factors has been recognized through the United States health objectives. HR and BP assessment may identify potential cardiovascular risks during a physical therapy intervention and assists in determining a patients' plan of care. A PT's decision to include or omit these measures could impact a patient's overall health and wellness.

ANAEROBIC THRESHOLDS OF PATIENTS AFTER TRAUMATIC BRAIN INJURY: COMPARISON TO HEALTHY SEDENTARY CONTROLS.

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Purpose/Hypothesis: The purpose of this investigation was to compare the anaerobic thresholds (AT) of individuals with a traumatic brain injury to healthy sedentary controls. **Number of Subjects:** Twelve patients who had previously suffered a traumatic brain injury (TBI; 7 males and 5 females) were compared to 12 apparently healthy sedentary control subjects (CON; 6 males and 6 females) with no known history of brain injury. Participants with TBI were admitted to a post-acute residential treatment center and had no obvious physical impairments. They were admitted primarily for cognitive and behavioral therapy. All subjects gave informed written consent. **Materials/Methods:** All subjects performed a graded maximal treadmill test where ventilation and expired gases were measured continuously with an automated metabolic cart. Heart rate (HR) was measured with a three lead electrocardiogram. After testing, AT was determined using the combined V-Slope and ventilatory equivalent for oxygen (VE / VO2) increase methods that closely corresponds with the lactate threshold. Exercise time, relative VO2 (mL . kg-1 . min-1), percent of VO2 max at AT, respiratory exchange ratio (RER; VCO2 production / VO2 consumption), and HR at AT were recorded and compared (Bonferroni adjusted t-tests; alpha = 0.05). **Results:** For subjects with TBI, the AT occurred 2.9 minutes earlier than the CON subjects ($p = 0.04$). The VO2 at AT was 12.8 ± 4.6 and 20.4 ± 5.0 mL . kg-1 . min-1 in the TBI and CON, respectively ($p = 0.001$). AT occurred at 45.8 ± 9.6% (TBI) and 57.3 ± 7.9% (CON) of maximum VO2 ($p = 0.01$). There was no difference in the RER ($p = 0.81$) or HR ($p = 0.37$) at AT between groups. **Conclusions:** These data indicate that there is a marked difference in the AT of patients with a TBI compared to healthy sedentary individuals. While the onset of fatigue has multiple causes, these results suggest that the earlier onset of AT is likely a significant contributor to chronic fatigue experienced by individuals recovering from brain injury. **Clinical Relevance:** The AT values measured in this study for patients with a TBI are at or below the metabolic demands for many routine activities of daily living (e.g., sweeping, household laundry). When feasible, rehabilitation of patients with a TBI should include intense physical exercise as a primary intervention to improve aerobic capacity and delay the onset of significant anaerobic metabolism.

RELIABILITY OF AN ARMBAND ENERGY EXPENDITURE MEASUREMENT DEVICE: A META-ANALYSIS.

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Purpose/Hypothesis: Physical therapists require accurate energy expenditure measures to develop safe, effective exercise and weight management protocols. Current measures require sophisticated laboratory equipment. A lightweight, portable armband device is available, but reliability has not been evaluated through systematic review

and meta-analysis. This meta-analysis examined differences and agreement between the Sensewear Armband (SWA) and simultaneous gold standard measures using indirect calorimetry (IC). **Number of Subjects:** 19 studies (n=1299) containing 54 total trials (resting, exercising, and total daily calories) were found that provided means and standard deviations in kcal/min. **Materials/Methods:** Systematic review and random effects meta-analysis were performed using criterion studies that compared SWA to simultaneous IC using stationary or portable metabolic carts. **Results:** Analysis found the combined average overall difference was 0.057 kcal/min (95% CI=-0.079 to 0.194), (tau squared= 0.177) (d=0.042), the average resting measure difference from 10 trials (n=428) was 0.030 kcal/min (95% CI = -0.074 to 0.135), (d=0.027, tau squared=0.024), the average exercise difference from 35 trials (n=702) was 0.068 kcal/min (95% CI=-0.370 to 0.507), (d=0.074, tau-squared=1.588), and total daily measure difference from 9 trials (n=169) was 0.067 kcal/min (95% CI=-0.180 to 0.315), (d=-0.077, tau-squared=0.116). Five studies with 13 trials (n=316) presented only Pearson r-value terms. Average combined overall agreement was r=0.795 (95% CI=0.698 to 0.863) (tau squared=0.116), average rest agreement from 4 trials (n=106) was r=0.766 (95% CI=0.669 to 0.838), tau squared< 0.001), average exercise agreement from 7 trials (n=179) was r=0.770 (CI=0.596 to 0.875), (tau squared= 0.158), and average daily total measurement agreement for 2 trials (n=31) was r=0.915 (95% CI=0.693 to 0.979), (tau squared=0.154). **Conclusions:** Meta-analysis results suggest that mean SWA does not significantly differ from IC. Further, agreement between SWA and IC based on r-value correlations was good; therefore, SWA measures appear comparable to IC for the conditions examined. Further study is recommended to examine SWA reliability during low intensity activities and in individuals with health or movement limitations. **Clinical Relevance:** This study suggests that the SWA is an effective method for measuring energy expenditure during exercise activities.

AGREEMENT OF ARMBAND ENERGY EXPENDITURE MEASURES TO INDIRECT CALORIMETRY FOR ACTIVITIES OF DAILY LIVING: A RELIABILITY STUDY.

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Purpose/Hypothesis: Physical therapists require accurate measures of energy expenditure to develop safe and effective rehabilitation protocols. The Sensewear Armband (SWA) Kilocalorie (Kcal) measures appear comparable to indirect calorimetry (IC) for exercise activities; however, agreement between SWA and IC has not been determined for low intensity activities commonly used in rehabilitation. In addition, agreement between SWA measures obtained from the right arm (RA) compared to the left arm (LA) has not been assessed. This study examined agreement between SWA and IC for rest and five activities of daily living (ADLs) and then examined agreement between RA and LA measures. **Number of Subjects:** Following Institutional Review Board approval, ten female volunteers (26.4 ± 2.6 yrs) signed informed consent and participated in the study. **Materials/Methods:** A prospective methodological design assessed agreement between simultaneous IC using a Metabolic Cart and SWA RA and LA measures. Participants performed five ADLs, three times for three minutes (90 data points per activity), using standardized, timed movements. **Result :** Overall average Kcals for all activities were 2.18 ± 1.20 for IC, 2.02 ± 0.96 for RA, and 2.00 ± .91 for LA. Overall agreement between IC and RA (ICC=.570, p=.500) and IC and LA (ICC=.449, p=.500) was not significant; RA was 6.99% lower and LA 7.95% lower than IC. Overall agreement between RA and LA was significant (ICC=.870, p=<.001) with LA 1.04% lower than RA. RA was not in significant agreement with IC at rest (ICC=.331, p=.500)at 4.35% lower, or for supine-to-sit transfers (ICC=.254, p=.494) at 45.47% lower; sit-to-stand transfers (ICC=.538, p=.439) at 30.19% lower; donning a sock (ICC=.192, p=.500) at 16.85% higher; combing hair (ICC=.434, p=.491) at 24.07% higher; and donning a shirt (ICC=.457, p=.459) at 60.72% higher. **Conclusions:** Study results suggest that agreement between SWA and IC Kcal measures were not significant during low intensity ADLs. Further study is recommended to determine whether temperature variations during rest or low intensity activities are not sufficient for detection and interpretation. Study results suggest armband measures taken from the right or the left arms are comparable. **Clinical Relevance:** The SWA requires further development to provide reliable energy expenditure measures during rest or low intensity activities of daily living. Bilateral use of SWA is not contraindicated.

Poster Presentations

CARDIOVASCULAR EFFECTS AND ENERGY EXPENDITURE IN HEALTHY NORMAL CHILDREN DURING HORSEBACK RIDING: A PILOT STUDY.

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Purpose/Hypothesis: The purpose of this study was to investigate the effects of horseback riding on the heart rate (HR), blood pressure (BP), rating of perceived exertion (RPE), and caloric expenditure of normal healthy children. It was expected that HR, BP, RPE, and caloric expenditure would increase during horseback riding. **Number of Subjects:** Twelve healthy normal children (mean age = 10.333 years, SD=1.371 years). **Materials/Methods:** A parent of each volunteer participant completed the informed consent process. Participants completed a pretest survey and obtained pretest HR, BP, RPE, and caloric expenditure measurements. The participant rode in their usual horseback riding lesson and wore a portable heart monitor to measure the mean HR, maximum HR, and calories expended during the lesson. Posttest HR, BP, RPE, and caloric expenditure

measurements were obtained and participants completed a posttest survey. **Results:** There was a statistical difference between the maximum HR during the lesson and pretest HR, maximum HR and posttest HR, maximum HR and mean HR during the lesson, mean HR and pretest HR, mean HR and posttest HR, but not between the posttest HR and pretest HR. There was a statistical difference between calories expended and calories expended per minute at pretest and during the lesson and between the lesson and at posttest, but not between the calories expended and calories expended per minute at pretest and posttest. A high positive correlation existed between the participant's mean HR and calories expended per minute during the lesson. A moderate negative correlation existed between the length of the lesson and the calories expended per minute during the lesson. A moderate-high positive correlation existed between the participant's riding experience and the calories expended per minute during the lesson. A statistical difference was not found between pretest and posttest BP. Despite the increased HR and caloric expenditure during riding, approximately half of the participants reported horseback riding as physical exercise. This study supported the classification of horseback riding as a physical activity by the US Department of Health, ranging from moderate activity with general horseback riding activity and vigorous activity dUring horseback riding at higher speeds. The mean rate of calories expended per minute in this study is 3.174 calories per minute (SD = 1.150), or approximately 190 calories per hour. This is comparable to moderate speed walking. **Conclusions:** The results suggest an increased HR and caloric expenditure during horseback riding in healthy normal children. Further research is needed to assess what aspects of horseback riding – riding style, duration, speed, etc. – contribute to increased caloric expenditure, as well as whether similar or different cardiovascular changes and energy expenditure would be seen in children with pathology. **Clinical Relevance:** Although this pilot study demonstrates some physiological changes in healthy normal children during horseback riding, it may not necessarily be perceived as physical activity.

EXAMINATION OF THE ASSOCIATION BETWEEN A CHILD'S HEALTH BEHAVIOR AND THE HOME ENVIRONMENT AND THEIR HR, BMI, FLEXIBILITY AND STRENGTH MEASURES.

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Purpose/Hypothesis: Determine the association between a child's health behavior and access to healthy living and their HR, BMI, flexibility and strength measures. Additionally, determine if an educational-based intervention for second and third graders would improve attitudes towards exercise, physiological measures and physical performance. **Number of Subjects:** Subjects were 54 2nd and 3rd grade students at The Odyssey School, an expeditionary learning charter school. **Materials/Methods:** A survey was distributed to the students that was completed at home with their parents. The survey consisted of questions regarding physical activity (PA) levels,attitudes about health, nutrition and the environment. Child's height and weight were collected for pre/post comparison. Various physical performance tests were also administered. Following the pretest measures educational segments were conducted to include: small group discussions about nutrition and physical activity, pro-section observation of human and cow hearts and lungs, and instruction on self monitoring of HR. Six months later, post-test measures were performed. Data analysis included descriptive statistics to define demographics, paired t-test to determine pre-and post test differences, and linear regression models to determine if certain behaviors or attitudes predicted the various outcome variables. **Results:** The cohort, with complete data sets, included 28 subjects. The cross-sectional group, with complete posttest data, included 42 subjects. Cohort data revealed a large variance in the percentile BMI (%BMI) with standard deviations of 27.64 and 24.34. Only two students fell in the category of overweight (%BMI>95), six students were underweight (%BMI<5) and 20 fell into a normal range. Students showed positive trends towards increased PA and better nutritional habits, as well as increased parental PA. Cohort data revealed a significant change in attitudes towards healthy behaviors. Cross-sectional data analysis revealed 20% of the variance in shuttle-run can be attributed to health attitudes. **Conclusions:** Health attitudes of students and parents can be affected by educational interventions with subsequent trends towards increased PA. Future research is vital to further examine if this intervention model can positively influence a child's attitude towards exercise, physiological status and physical performance. Further studies using a larger sample, greater age variance, diverse socioeconomic groups and specific educational/physical interventions are necessary to determine the generalizability of this research. **Clinical Relevance:** Rising levels of childhood obesity demonstrate a need for effective and relevant strategies to combat this epidemic. This research demonstrates the appropriateness of physical therapist lead educational intervention in a school based setting in relation to health and wellness attitudes. Emphasizing physical fitness and healthy lifestyles to children at a young age can positively affect their health attitudes as well as resonate to those around them.

THE USE OF CARDIOPULMONARY OBJECTIVE QUALITY OF LIFE MEASURES IN PHYSICAL THERAPY PRACTICE: A QUALITATIVE STUDY.

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Purpose/Hypothesis: The purpose of the study was to gather information regarding the use of objective cardiopulmonary quality of life measures among cardiopulmonary physical therapists, to determine their use in the clinical setting, as well as to determine any barriers which prevent their use. **Number of Subjects:** N = 11, all subjects were members of

the cardiovascular and pulmonary section and were recruited on the section's list serv. A majority of subjects were board certified CCS. **Materials/Methods:** This study consisted of three 45 minute conference style phone interviews. Subjects were provided with a copy of the consent form and list of semi-structured interview questions prior to phone call. The question list contained the following questions: 1) Describe the setting in which you work: 2) Describe the patients on your primary case load: 3) Are you familiar with Quality of Life Measures? If so, which ones? 4) Are you familiar with Quality of Life Measures specific to the cardiopulmonary patient? 5) Are you currently using any quality of life measures in your practice? If yes: How are they currently being used? How often? Do you feel the tool used in your clinic provide a measure and detailed account of cardiovascular status? If no: What are the barriers to the use of these tools? Explain? What would encourage you to use an objective quality of life measure in your practice? Following the interview, data transcription began immediately. Data analysis involved evaluating patterns in the responses among the participants. **Results:** The following themes were obtained: 1) PTs are not as familiar with disease specific scales. 2) Administrative and cost limitations interfere with access to measures. 3) Current measures are not appropriate for use in the acute care environment due to the length of stay and acuity/cognition of patients. 4) Function and quality of life are not correlating on currently available scales. 5) Measures do not take environment enough into consideration. 6) Trust in the subjective response of the patient/patient literacy and understanding of the tool is low. 7) A quality of life measure that more accurately measures depression and function would be of value. **Conclusions:** 1) Development of a quality of life tool for use with the short term or acute patient is necessary. 2) Administrative and cost barriers must be addressed. 3) Development of a quality of life measure that takes into account the relationship between function, environment and quality of life is necessary. 4) Education on disease specific quality of life measures is needed. 5) A tool in which depression and function's influence on quality of life can be quantified should be designed. 6) Literacy of the patient may be biasing outcomes on quality of life measures. **Clinical Relevance:** The use of objective measure to provide data on quality of cardiovascular and pulmonary intervention is essential. This study leads to many opportunities for future research.

COMPARISONS OF CARDIOVASCULAR ENDURANCE AND PHYSICAL ACTIVITY BETWEEN SUPERVISED AND HOME-BASED 8-WEEK EXERCISE TRAINING PROGRAMS IN INDIVIDUALS WITH BELOW-KNEE AMPUTATION – A PRELIMINARY REPORT.

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Purpose/Hypothesis: The purpose of this study is to examine the effects of 8-week exercise programs between a supervised group and a home-based group on cardiovascular endurance and physical activity in individuals with limb amputation. **Number of Subjects:** Eight sedentary individuals with stable medical conditions and who walked independently with a prosthesis enrolled in the study. They were randomly assigned to either supervised fitness training or home-based exercise group. Four subjects with below-knee amputation completed the study at this time with two in each group (age: 57±12 yr, BH: 175±12 cm, BW: 107±0.15 kg, Waist to hip ratio (WHR): 0.99± 0.15). Informed consent was obtained. **Materials/Methods:** Two trials of the six-minute walk test (6MWT) were conducted within a week before training, with test-retest reliability determined for the eight subjects (ICC=0.984). During the 6MWT, heart rate was monitored continuously by telemetry electrocardiogram. Blood pressure, oxygen saturation, and Rating of Perceived Exertion were recorded pre- and post-6MWT. 6MWT was conducted for all subjects again after training. The supervised training group received comprehensive aerobic, resistive (core, upper and lower body), and balance exercise training 3 times per week in our facility. The home-based group performed a walking program on their own and specific exercises according to a specially designed home exercise booklet, including balance and strengthening exercises with free weights. Free weights were provided at the initial session and upgraded in the 4th week. In addition, each subject was provided with a pedometer to record daily step counts during the 8 weeks. Descriptive statistics was used for analysis of the 6MWT, and linear regression was used to analyze the trend of step counts over the 8 weeks. **Results:** Slight improvement was observed for the 4 subjects: BW 105 ±30 kg, WHR: 0.96 ± 0.12. The 6MWT showed an increase in distance and a decrease in heart rate. Respectively, the supervised group showed increased distance by 3.76%, decreased heart rate by 12.2%; while home-based group had increased distance by 6.77% and increased heart rate by 0.66%. Step counts did not change much in the home-based group, but there was a moderately positive linear increase in the supervised training group. **Conclusions:** Both programs seemed to improve cardiovascular endurance in people with below-knee amputation, but the supervised training group seemed to show a slightly better metabolic efficiency and physical activity. No definite conclusions could be made at this time yet due to the small sample, and the study is still ongoing. **Clinical Relevance:** Effective and feasible fitness programs for sedentary individuals with amputation are important for health promotion. This study may provide some insights on viable options of fitness training programs for individuals with limb amputation. Acknowledgement: We appreciate the funding support from the Texas Physical Therapy Foundation for this project.

A NON-TRADITIONAL APPROACH TO CARDIAC REHABILITATION IN THE DIALYSIS CENTER FOR A PATIENT WITH END-STAGE RENAL DISEASE FOLLOWING CORONARY ARTERY BYPASS SURGERY: A CASE REPORT.

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Background & Purpose: Cardiac Rehabilitation promotes positive outcomes after coronary artery bypass grafting

(CABG) surgery. Patients with end-stage renal disease (ESRD) have an increase risk of cardiac mortality and morbidity. Cardiac rehabilitation for patients with ESRD after CABG also produces positive outcomes. However, participation in cardiac rehabilitation continues to be limited due to lack of physician referrals, patient compliance, accessibility and time constraints. Can a cardiac rehabilitation program be implemented safely and effectively following CABG in a patient during dialysis sessions? **Case Description:** The patient was a 43 year old male with a history of ESRD requiring hemodialysis, CABG, and hypertension (HTN). During dialysis treatments, the patient received cardiac rehabilitation which included aerobic exercise and education for 16 weeks under the direct supervision of a physical therapist. **Outcomes:** The patient gained improvements in: quality of life based on the SF-36 score, exercise time, 2 minute walk distance, and had a reduction in cardiac risk factors. No adverse effects occurred during the intervention. **Discussion:** A 16 week cardiac rehabilitation program may be implemented safely and effectively following CABG in a patient while undergoing concurrent dialysis. This patient demonstrated improved outcomes comparable to patients who received traditional cardiac rehabilitation following CABG.

RELIABILITY AND VALIDITY OF THE END TIDAL CO2 FROM THE CAPNOTRAINER.

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Purpose/Hypothesis: The purpose of this study was to establish the validity and reliability of end-tidal carbon dioxide (ETCO2) measurements as obtained by the Capnotrainer. We hypothesized that the measures from the Capnotrainer would be valid and reliable for the measurement of ETCO2. **Number of Subjects:** The sample consists of 29 subjects for the validity portion and 30 subjects in the reliability portion. **Materials/Methods:** This study was performed as 2 separate studies and is now combined for the purpose of presenting both reliability and validity of the Capnotrainer. Both included a sample of convenience of males and females over the age of 18, with no known respiratory disease. Subjects completed a health questionnaire prior to each testing session which included questions about stress levels and exercise habits. Subject's respiration rate and CO2 were measured and recorded via a nasal cannula using the CapnoTrainer capnograph, during a series of 7 challenges, which were developed by a clinician. These included sitting quietly, standing quietly, four deep breaths, reading, timed breathing, mental math, and lying quietly. Time to recovery from reading and the deep breaths was also recorded. Reliability: Subjects were tested on 2 occasions, 1 week a part. Vital signs were recorded prior to testing. The tester was blinded to the health questionnaire and vitals. Validity: Additional exclusions for the validity study included anxiety disorders, panic attacks or claustrophobia. In addition to testing with the Capnotrainer, each subject performed the same 7 challenges using the MedGraphics Cardiopulmonary Exercise System, which uses open circuit spirometry. ICC's were used to determine reliability and Pearson Correlations were used for validity. Relationships were considered significant if at the .05 level of probability. **Results:** ICC values ranged from .86 for recovery from deep breathing to a low of .56 during supine respiration. Values for correlation between the two devices ranged from r = .68 to .79. Follow-up t-tests showed significant differences between measures from each of the 7 breathing activities. **Conclusions:** While all 7 of the challenges were statistically reliable, none of the challenges were proven to be clinically reliable based on their interclass correlation coefficients. The ETCO2 results obtained by the Capnotrainer were found to be significantly different from those of the MedGraphics system for all seven challenges. Thus, the validity of the Capnotrainer for end tidal CO2, as compared to open circuit spirometry, is limited. **Clinical Relevance:** Emerging ideas propose that a capnograph could be used to detect CO2 levels that may result in inappropriate acid-base chemistry in the body. Inappropriate levels of ETCO2 might reflect the need for a behavioral intervention in addition to typical physical therapy. While our findings suggest that the validity and reliability of this instrument, with these tests is not high, other test methods or uses may be better. This tool could be used as a biofeedback tool, helping patients learn how to breathe properly and restore normal CO2 levels.

INFLUENCE OF ACTIVITY LEVELS VERSUS ENERGY INTAKE ON PERCENT EXCESS WEIGHT LOSS (%EWL) AFTER ROUX-EN-Y GASTRIC BYPASS PROCEDURES (RYGBP).

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Purpose/Hypothesis: Purpose: Obesity is epidemic in the industrial world's populations costing hundreds of billions of dollars to treat annually. The NIH has approved gastric bypass as the only predictable, medically acceptable, and successful intervention for loss of substantial weight in the morbidly obese. The RYGBP is accepted as the best procedural intervention to reduce and control weight in the morbidly obese population and numerous procedures are performed each year. To maximize outcomes from the surgery, most surgeons utilize the same interventions which are routinely used and deemed to be successful in the non-surgical obese population. Non-surgical success is greatest with dietary control with activity used to maintain weight loss. The purpose of this study was to define variables that improve success in %EWL in this post-surgical population. Hypothesis: Increased activity will improve %EWL after bariatric surgery. **Number of Subjects:** 265. Return rate was 33%. **Materials/Methods:**The Arizona Activity Frequency Questionnaire, the Arizona Food Frequency Questionnaire, and the SF-36 Health and Quality of Life survey were sent to all of the RYGBP patients who had surgery one to five years prior to the study and performed through the same "Center

of Excellence" bariatric surgery center (returned n=265 or 33%). Results of these tools, as well as demographic and medical follow-up data from this patient pool, were utilized to determine influences of activity and dietary behaviors on the outcomes of BMI. Analysis was performed on all of the pertinent data collected through individual ANOVA testing to determine relationships between selected behaviors and outcomes. **Results:** There was no significant relationship between energy intake (measured in kilojoules) and post-surgical % excess weight loss (%EWL). Significant differences were found in %EWL between patients participating in more energy expended in activity/day ($p < 0.05$), more hours of activity/day ($p < 0.02$), and those participating in more MET Level 3 activities/day ($p < 0.03$) than those with lower energy expended in activity/day, lower hours of activity/day and those with less MET Level 3 activities/day. **Conclusion:** Outcomes s/p RYGBP, when measured in %EWL, is improved when the patient expends more energy in activity/day, is more active in hours of activity/day or is more active with higher MET Level 3 activities and is not significantly improved with change in energy intake. **Clinical Relevance:** As physical therapist get more involved with the post bariatric surgery populations, emphasis on energy expended in activity/day, hours of activity/day, or higher MET level activity/day need to be incorporated in post RYGBP protocols to improve post surgical outcomes in %EWL.

DEVELOPING A CLINICAL PREDICTION RULE FOR SCREENING ADOLESCENT FEMALES FOR CARDIOVASCULAR DISEASE RISK.

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Purpose/Hypothesis: The purpose of the current study was to initiate development of a clinical prediction rule for identifying adolescent females at risk for developing cardiovascular disease using tests that can be conducted economically and efficiently in the school setting. **Number of Subjects:** 28 **Materials/Methods:** Six anthropometric indicators of body fatness, seven measures of physical fitness, and seven metabolic and hemodynamic CVD risk factors were measured in a convenience sample of 28 female high school students (15-18 years of age). A CVD risk score was calculated by adding the number of metabolic and hemodynamic prognostic factors for which each subject tested outside the normal reference range. Correlation analyses were completed to determine the association between the CVD risk score and other study variables. Stepwise linear regression analyses were completed to determine if anthropometric or fitness variables were significant predictors of the CVD risk score. **Results:** Sixteen girls had HDL cholesterol levels lower than 36 mg/dl, 16 had BMI greater than 25 kg/m2 (age and gender adjusted); 13 had TC values above 170 mg/dl; 11 had SBP above 124 mmHg; 8 had DBP above 81 mmHg; 6 had VLDL above 40mg/dl; 2 had TG above 168 mg/dl, and 2 had fasting blood glucose values above 100 mg/dl. None of the girls had LDL cholesterol levels above 110 mg/dl. All anthropometric indicators of fatness were highly significantly correlated with CVD risk ($P \leq 0.0001$) while only three fitness variables reached a lower level of significance ($P \leq 0.05$). Waist circumference (WC) was the single best anthropometric or fitness predictor of the variance in CVD risk factors (r2 0.742; p 0.004). According to the prediction equation generated by this linear regression analysis, CVD risk could be predicted as CVD Risk = (-4.48 + (WC * 0.209)). Systolic blood pressure (SBP) was the single best predictor of the variance in CVD risk when all study variables were considered (r2 0.932; p 0.0001). According to the prediction equation generated by this linear regression analysis, CVD risk could be predicted as CVD Risk = (-36.56 + (SBP * 0.334)). **Conclusions:** Non-invasive measures that are easily obtained in the school setting may be useful in identifying adolescent females at high risk for developing CVD. This study is novel in that it focused on using non-invasive, inexpensive, field-based measures to predict CVD risk in adolescent females. It is especially unique in that it included fitness tests as prognostic indicators for CVD risk. **Clinical Relevance:** The fact that anthropometric measures are significantly correlated with CVD risk in adolescents and WC and SBP are significantly predictive of CVD risk in adolescents means that such measures should be implemented as part of a critical pathway in identifying and targeting at-risk youth for early and accelerated intervention and referral for further testing. Further research using random sampling from additional populations is warranted for validating these prediction rules and for expanding the external validity of this study.

CHANGES IN BMI AND BLOOD PRESSURE FOLLOWING A 10 WEEK EXERCISE AND NUTRITION PROGRAM FOR CHILDREN WHO ARE OVERWEIGHT OR OBESE.

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Purpose/Hypothesis: Obesity and overweight constitute a health problem affecting an increasing number of children. Children who are overweight/obese are prone to other medical conditions such as high blood pressure, abnormal lipid profiles, insulin resistance, and type II diabetes mellitus. This study explored whether an exercise and nutrition program, for children with known cardiovascular risk factors, would decrease BMI and blood pressure. The purpose of this poster is to describe the Fit Kids for Life program and report the outcomes of a sample of overweight and obese children. Our hypothesis was that children who successfully completed the program would have a decrease in BMI and blood pressure. **Number of Subjects:** Children, aged 8-17(n=261)who had at least one cardiovascular risk factor (hypercholesterolemia, hypertension, or were overweight / obese as defined as ≥85th percentile BMI) participated in a 10 week exercise and nutrition, lifestyle modification program. **Materials/Methods:** Children were either referred to the program (Fit Kids for Life) by local

pediatricians or self referred. Baseline height, weight, BMI [weight in kilograms divided by the square of height in meters], and blood pressure were obtained. Children and their families participated bi-weekly, in the 10 week program which consisted of 1 hour of nutritional education, and 3 hours of structured exercise. The program was administered by a pediatric cardiologist, physical therapist, dietician, and utilized over 30 medical/ physical therapy students as mentors / trainers. The exercise component consisted of three "stations": 1)"cardiovascular corner"- where the child engaged in 15-20 minutes of cardiovascular exercise, 2)"core on the floor"- where stabilization and floor work using body weight were performed, and 3)"muscle mania"- where a circuit of weight machines was performed. In addition, a 1.5 mile walk/jog/run was performed weekly. Following completion of the program, blood pressure and BMI were obtained. **Results:** At baseline, BMI = 34.05 ± 0.45, systolic BP (mmHg) = 121.70, ± 1.14, and diastolic blood pressure = 70.36 ± 0.69 [all results, mean ± SEM]. Children who completed the program (n = 179; 68.9% retention) demonstrated improvement in BMI = 32.99 ± 0.51 ($p<.001$), systolic BP = 114.43 ± 1.08 ($p<.001$), and diastolic BP = 65.77 ± 0.81($p<.001$). **Conclusions:** Children enrolled in the Fit Kids for Life program demonstrated a decrease in BMI and blood pressure. This study supports that small changes in diet and exercise, as reinforced by a community based program, can improve cardiovascular risk factors in overweight and obese children. **Clinical Relevance:** Fit Kids for Life has been shown to improve cardiovascular health in overweight and obese children. Halting the progression of complications related to obesity is imperative for this generation of children who are anticipated to have shorter lifespans than their parents. The role of the physical therapist as expert in development and implementation of community based exercise program is perceivable.

DO CARDIAC AND PULMONARY PATIENTS ENROLLED IN A HOSPITAL-BASED REHABILITATION PROGRAM DEMONSTRATE CLINICALLY SIGNIFICANT IMPROVEMENTS?

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Purpose/Hypothesis: The primary purpose of the current study was to relate changes in six minute walking distance to changes in activities of daily living for cardiac and pulmonary patients upon completion of a 7-wk hospital-based rehabilitation program. **Number of Subjects:** 57. **Materials/Methods:** Participation in this study was voluntary and based on physician diagnosis. Participants completed a 20-hour, 7-wk Phase II OPCR. The 6MWT was conducted at baseline and again after completing the rehabilitation program. Oxygen saturation percentage (SPO2%), heart rate (HR), rating of perceived exertion (RPE), and shortness of breath (SOB) scores were recorded at baseline, at every minute mark during the 6MWT, and at one minute post-exercise (recovery). Repeated measures (RM) general linear model (GLM) tests were completed to determine if there were statistically significant within-subject differences between pre- and post 6 MW distances (6MWD) or between each of the six minutes of exercise for SPO2%, HR, RPE, and SOB. 6 MWD was converted to metabolic equivalent (MET) and activities of daily living (ADL) levels. **Results:** Both the cardiac and pulmonary groups showed statistically significant improvements in the 6MWD ($P \leq 00001$), but not in minute-by-minute changes for SPO2%, HR, RPE, or SOB ($p \geq 0.05$). 6 MWD, MET and ADL data are presented below.

Pre 6 MWT distance: Cardiac 566.49 m; Pulmonary 440.00 m
Post 6 MWT distance: Cardiac 697.00 m; Pulmonary 519.47 m
Gain in distance: Cardiac 130.50 m; Pulmonary 79.47 m
Pre MET: Cardiac 3.26; Pulmonary 2.75
Post MET: Cardiac 3.77; Pulmonary 3.10
MET gain: Cardiac 0.51; Pulmonary 0.35
Number who increased an ADL Level: Cardiac 22 out of 32; Pulmonary 11 out of 25

Conclusions: Previous researchers have reported that for increases in 6MWD to be significant they should be between 50 and 70 meters for pulmonary patients and closer to 170 meters for cardiac patients. The current study met these gains in pulmonary but not cardiac patients. However, a statistically significant mean increase in 6MWD does not necessarily equate to a clinically significant improvement for an individual patient. In the current study, 22 of the 32 cardiac patients increased one entire ADL level in response to the rehabilitation program which provides an alternative form of evidence for clinically-relevant patient improvement and program efficacy. Previous researchers have compared gains in 6 MWD to questionnaire-based indices of functional status, subjective improvements in quality of life and dyspnea, and clinical measures of peak oxygen uptake and FEV1. To our knowledge, the current study is the first to convert changes in 6 MWD to changes in MET and ADL levels. The current study provides evidence that converting the change in a 6 MWD to changes in MET and ADL levels can provide a clinically-relevant index of patient's improvement. **Clinical Relevance:** Converting changes in 6MWD to changes in MET and ADL levels provides a valuable metric for assessing the clinical significance of changes in 6MWD.

LOWER EXTREMITY STRENGTH TRAINING FOLLOWING ACUTE LUNG TRANSPLANTATION: PRELIMINARY ANALYSIS.

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Purpose/Hypothesis: Quadriceps weakness can account for a large proportion of exercise intolerance following lung transplantation (LT). However, optimal strength training doses have not been investigated for adults who have recently undergone LT. The purpose of this study was to identify changes in quadriceps strength in response to hospital-based rehabilitation following LT. We hypothesized

that high-volume strength training (HVST) would result in greater improvements in strength than low-volume strength training (LVST). **Number of Subjects:** Six male adults (42-64 years) consented to participate in this IRB-approved study. **Materials/Methods:** Participants underwent training consisting of stretching, education, treadmill walking and lower extremity strength training, scheduled 5 days per week for up to 4 weeks. Patients were randomly assigned to receive either LVST (N=3), consisting of 1 set of 8 repetitions of training, or HVST (N=3), consisting of 3 sets of 8 repetitions every day of therapy. Strength training consisted of leg press, knee extension and knee flexion exercises between 50% and 70% of 1-RM. Quadriceps strength was clinically analyzed before and immediately after the training period using 1-RM for leg press and knee extension. Peak isokinetic (60 deg/s and 120 deg/s) and isometric knee extension torque was assessed with a Biodex dynamometer. We tested six-minute walk distance (6MWD) to estimate functional mobility. Generalized strength was monitored using grip dynamometry. Variables were analyzed with Wilcoxon and Mann-Whitney U tests. To compare the effects of training volume on strength, data were normalized to body mass. Median values are reported, and significance was established at $p<0.05$. **Results:** Prior to training, BMI was significantly greater in the HVST group (26 vs 22, $p= 0.05$). Other demographic variables did not differ between the groups. Patients demonstrated significant quadriceps weakness (39% of age predicted) at the onset of rehabilitation. Patients began strength training a median 22 days following surgery, and completed 17 training sessions over 4 weeks. Leg press 1-RM increased 28% after training (135 to 173 lb, $p< 0.05$), while knee extension 1-RM increased 60% (113 to 190 lb, $p< 0.05$). Peak isokinetic torque increased at slow (Pre: 136%, Post: 165% of BM, $p< 0.05$) and fast (Pre: 109%, Post: 142% of BM, $p< 0.05$) speeds, in conjunction with improved isometric torque (Pre: 131%, Post: 154% of BM, $p< 0.05$). 6MWD increased significantly after training (400 to 1282 ft, $p< 0.05$). Grip strength did not significantly change (68.9 to 71.2 lb, $p> 0.05$). The degrees of improvement in 1-RM, torque and 6MWD did not differ between the training groups ($p> 0.05$), although post-training power tended to improve in the HVST group (60 deg/s, $p= 0.10$). **Conclusions:** The results suggest that quadriceps strength increases with training, but HVST may provide an added power benefit to patients. **Clinical Relevance:** This study may help therapists identify benefits and optimal doses for improving quadriceps strength and function in the early recovery period following LT.

PHYSICAL FUNCTION, AGE, AND MENTAL STATUS ARE RELATED TO PHYSICAL ACTIVITY AND EXERCISE SELF-EFFICACY 3, 6, AND 12 MONTHS FOLLOWING CORONARY ARTERY BYPASS SURGERY.

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Purpose/Hypothesis: Increased habitual physical activity is an important health-promoting behavior for patients to adopt following coronary bypass (CAB) surgery. The purpose of this study was to examine the relationship between patient functional status at the time of hospital discharge and physical activity level and exercise self-efficacy 3, 6, and 12 months following CAB surgery. **Number of Subjects:** This study included 28 patients hospitalized following CAB surgery. Study participants were 65 years of age or older, within two days of discharge, and able to understand English. Patients who had concurrent heart valve replacements, new onset of stroke, or significant cognitive deficits were excluded from the study. **Materials/Methods:** This prospective descriptive study used a sample of convenience recruited from a regional medical center. Baseline outcome measures obtained prior to hospital discharge included the Heart Surgery Symptom Inventory (HSSI), Telephone Interview of Cognitive Status (TICS), Timed-Up-and-Go (TUG), 2 Minute Walk Test (2MWT), hand grip strength (HG), and the Timed Sit-to-Stand (STS). Follow-up measurements of habitual physical activity level and exercise self-efficacy were obtained via telephone interview at 3, 6, and 12 months following CAB. Habitual physical activity level was measured using the Baecke Physical Activity (BPA) Questionnaire. The Self- Efficacy for Exercise Behaviors (SEB) Scale was used to quantify patient perceived confidence in exercise participation. Higher scores on the SEB Scale indicate better self-efficacy than lower scores. Data were analyzed using descriptive statistics and Pearson correlations. **Results:** Study participants were predominately Caucasian (100%) and men (82%), 73±7 years old with a BMI of 28.1±2.6 kg/m2 (mean ± SD). Baseline TUG and 2MWT scores were correlated with BPA scores at 3, 6, and 12 mo post-CAB surgery ($r = |0.40\text{-}0.61|$). In addition, baseline HSSI scores were correlated with follow-up SEB scores at 3 and 6 months. Scores on the TICS were correlated with 3 mo SEB scores ($r = 0.53$) and 6 and 12 month BPA scores ($r = 0.44$ and 0.60). Age was inversely correlated with 3 month SEB scores. **Conclusions:** Study results suggest that physical function at the time of hospital discharge is related to habitual physical activity level during the first year following CAB surgery. Symptom burden appears to be inversely associated with exercise self-efficacy 3-6 months post-CAB surgery. Additionally, patient cognitive function and age at the time of hospital discharge may influence habitual physical activity level after CAB surgery. **Clinical Relevance:** Patient functional status at the time of hospital discharge following CAB surgery may be an important predictor of habitual physical activity level. Physical therapists can identify and minimize exercise barriers related to functional limitations and thereby promote increased habitual physical activity level in this patient population.

IYENGAR YOGA VS. ENHANCED USUAL CARE ON BLOOD PRESSURE IN PATIENTS WITH PREHYPERTENSION TO STAGE I HYPERTENSION: A RANDOMIZED CONTROLLED TRIAL.

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Purpose/Hypothesis: The prevalence of prehypertension and Stage 1 hypertension continues to increase despite being amenable to non-pharmacologic interventions. Research has shown that yoga interventions are generally effective in reducing body weight, blood pressure, glucose level and high cholesterol. Iyengar Yoga (IY) has been purported to reduce blood pressure though evidence from randomized trials is lacking. **Number of Subject :** 26 and 31 subjects in the IY and EUC arms, respectively, completed the study. **Materials/Methods:** We conducted a randomized controlled trial to assess the effects of 12 weeks of IY vs. Enhanced Usual Care (EUC) (based on individual dietary adjustment) on 24 hour ambulatory blood pressure in yoga-naïve adults with untreated prehypertension or stage I hypertension. **Results:** There were no differences in blood pressure between the groups at 6 or 12 weeks. In the EUC group, 24 hr systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP) significantly decreased by 5, 3, and 3 mm Hg, respectively from baseline at 6 weeks ($p<0.05$), but were no longer significant at 12 weeks .In the IY group, 24 hr SBP was reduced by 6 mm Hg at 12 weeks compared to baseline ($p=0.05$). 24 h DBP ($p<0.01$) and MAP ($p<0.05$) decreased significantly each by 5 mm Hg. No differences were observed in catecholamine or cortisol metabolism to explain the decrease in blood pressure in the IY group at 12 weeks. **Conclusions:** 12 weeks of IY produces clinically meaningful improvements in 24 hr SBP and DBP. Larger studies are needed to establish the long term efficacy, acceptability, utility, and potential mechanisms of IY to control blood pressure. **Clinical Relevance:** Yoga, a form of physical activity, is rapidly gaining in popularity and has many health benefits. Yet healthcare providers have been slow to recognize yoga for its ability to improve health conditions, and few interventions have been developed that take full advantage of its benefits. Physical therapists have the opportunity to incorporate yoga based programs for patients with prehypertension or stage 1 hypertension.

EFFECTS OF AN INTENSIVE TASK-SPECIFIC REHABILITATION PROGRAM ON CARDIOVASCULAR EFFICIENCY IN INDIVIDUALS WITH CHRONIC STROKE.

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Purpose/Hypothesis: Diminished peak exercise capacity and increased energy demands for ambulation after stroke have functional and cardiovascular consequences. Intensive, task-specific rehabilitation programs have shown effectiveness for improving metabolic efficiency in persons with chronic stroke. However, the duration of training and type of activities included in these rehabilitation programs lack consistency in the literature. Therefore, the purpose of this study was to investigate how the cardiovascular system in individuals with chronic stroke responded to a short term, intense and task-specific rehabilitation program that included a whole-body approach. It was hypothesized that the group of participants would show improvements in cardiovascular efficiency immediately following the intervention and that changes would be maintained for five-months. **Number of Subjects :** A group of participants (n=9) who were at least six months post stroke, ambulatory at the levels of unlimited household or limited community walker (Perry et al, 1995), with minimal arm and hand function completed all phases of the study. **Materials/Methods:** The intervention consisted of a 3.25-hour interdisciplinary program, five days per week for two weeks that included intensive, task-specific interventions for the whole body. Pre-testing, immediate post-testing and five-month retention-testing consisted of determining each participant's VO2, metabolic equivalents (METS), heart rate (HR), and rating of perceived exertion (RPE) values following a metabolic testing protocol. Participants were required to attain a faster walking speed on the final testing stage during post- and retention-testing. Repeated measures analysis of variance ($p\leq0.05$) compared mean changes in metabolic variables attained during the final testing stages across all measurement phases. **Results:** Participants were able to walk at faster treadmill speeds during the final testing stages of post- and retentiontesting with no statistically significant differences in VO2 ($p=0.321$), maximal HR achieved ($p=0.338$) or maximal METS ($p=0.417$) across the three measurement phases. A decrease in mean RPE was shown following the intervention, but the change was only statistically significant from pre-testing to five-month retention-testing. **Conclusions:** Following an intensive two-week rehabilitation program, participants with chronic stroke were able to walk on a treadmill at higher speeds without an increase in the metabolic values of VO2, HR, or METS and with a reduction in self-reported RPE. **Clinical Relevance:** The findings of this study indicate that a short-term, intensive, task-specific rehabilitation program that focuses on the whole body may lead to a more efficient cardiovascular response.

THE EFFECTS OF LEVODOPA ON NOREPINEPHRINE AND CARDIOVASCULAR RESPONSES DURING MAXIMAL EXERCISE IN PARKINSON'S DISEASE.

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Purpose/Hypothesis: Exercise is a common modality used when treating and maintaining quality of life in individuals with Parkinson disease (PD). However, people with PD do not display normal exercise responses during graded exercise testing. One possible source of the abnormal exercise responses is the sympathetic nervous system (SNS) and the production of norepinephrine (NE). Levodopa, the most common drug used to treat PD, has been known to lower NE levels at rest. The purpose of this study was to examine how PD medication affects the autonomic

responses of individuals with PD during an acute exercise stress test. **Number of Subjects:** Fourteen with PD (Hoehn and Yahr Stage 2) and 15 healthy controls (HC) without PD. **Materials/Methods:** Participants underwent an exercise treadmill stress test using a Modified Bruce Protocol. Subjects with PD performed the test once off medication (PD-Off med) and then one week later on medication (PD-On med). Heart rate (HR), systolic blood pressure (BP), VO2, and NE levels were taken at rest and at peak exercise. Mixed model 2 x 2 ANOVAs (Group x test time) were used to compare the PD group (either PD-Off med or PD-On med) with the HC group at pre-test and peak exercise. Repeated measures 2 x 2 ANOVAs (Group x test time) were used to compare the PD-On with the PD-Off group. Tukey's post hoc tests were used to compare means when the interaction effect was significant. **Results:** At rest, HR, BP, and VO2 were similar ($p>0.05$), while NE levels were lower for the PD-On med and PD-Off med group as compared to the HC ($p<0.05$). In response to exercise all measures increased from resting values ($p<0.05$). At peak exercise HR, BP and NE values for the PD-On med and PD-Off med group were all significantly lower ($p<0.05$) than HC while VO2 was similar ($p>0.05$). **Conclusions:** Despite comparable peak VO2 in the HC and PD groups, the exercise responses were lower in those with PD regardless of medication state. NE was lower at rest and at peak exercise in both PD conditions which can help explain why HR and BP are lower in this population. **Clinical Relevance:** Autonomic abnormalities during exercise in those with PD appear to be disease manifested and not impacted by medications used to treat PD. Understanding these abnormalities and whether they are caused by disease or drug therapy allow for educated choices regarding exercise testing, interpretation and prescription.

EXERCISE TRAINING ADAPTATIONS IN WOMEN WITH VERY LOW INITIAL AEROBIC CAPACITY LEVELS: A COMPARISON STUDY.

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Purpose/Hypothesis: This study evaluated aerobic training adaptations in physiologic, anthropometric, and serum measures in women with initial aerobic fitness levels (VO2) below the 30th percentile rank compared to women with initial VO2 levels above the 30th percentile rank. **Number of Subjects:** 14 females (46.4 ± 11.4 yrs.) with low VO2 (22.86 ± 4.33 ml/kg/min) and 8 females (45.2 ± 10.1 yrs.) with average VO2 levels (33.67 ± 4.98 ml/kg/min) participated in training. Institutional review board approval was received, the study was voluntary, data was confidential and participants signed informed consent. **Materials/Methods:** Retrospective analysis of data from a nine-month worksite wellness program consisting of exercise training guidelines with opportunities for health promotion and wellness education through nutrition counseling, stress management seminars, and regular contact with health and fitness mentors. Pre and post test physiologic and anthropometric measures were performed by exercise science graduate students. Serum analyses were performed by two certified medical technicians. The Rockport 1 mile walk/run test was used to predict VO2. Wilcoxon Sign Rank test examined differences between pre and post test measures and Mann-Whitney U examined differences between groups using SPSS 11.0 with $p \leq .05$. **Results:** Women in the low fitness group significantly improved measures of VO2 ($p=.001$), resting heart rate ($p=008$), mass ($p=.002$), body fat percent ($p=.048$), triglycerides ($p=0.020$), and very low density lipoproteins ($p=.020$). VO2 increased 3.03 ± 2.05 ml/kg/min in the low fitness group which was similar to improvements in the average fitness group of 2.62 ± 1.38 ml/kg/min ($p=.311$) Adaptations for other variable measures were not significantly different between groups. **Conclusions:** Study measures indicate that women with very low baseline aerobic fitness levels experienced improvements in physiologic, anthropometric, and serum measures following training. In addition, training adaptations were not significantly different from women with average VO2 levels at baseline. **Clinical Relevance:** Study results suggest that women with very low aerobic fitness levels can benefit from voluntary workplace wellness programs and that improvements are similar to those of women with average fitness levels. Further study is recommended using larger samples to confirm these findings.

EXERCISE TRAINING ADAPTATIONS IN MIDDLE AGED WOMEN PARTICIPATING IN A WORKSITE WELLNESS PROGRAM: A COHORT COMPARISON STUDY.

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Purpose/Hypothesis: This study examined physiologic, anthropometric, and serum adaptations in middle aged women participating in a 9 month voluntary worksite wellness program who regularly performed aerobic exercise. Results were compared to women in the same program, who did not regularly perform aerobic exercise. **Number of Subjects:** 16 females (51 ± 6.4 years) participated regularly in aerobic exercise training and 23 females (52.6 ± 6.07) comprised the non-training group. Institutional review board approval was received, the study was voluntary, data was confidential and participants signed informed consent. **Materials/Methods:** The study design was a retrospective analysis of data from an onsite worksite wellness and research program. The wellness program consisted of exercise training guidelines with opportunities for health promotion and wellness education through nutrition counseling and stress management seminars. Participants had regular contact with mentors for information, motivation and support. Pre and post test physiologic and anthropometric tests were administered by exercise science graduate students and two certified medical technicians at the University's Health Center performed the serum analyses. Wilcoxon Sign Rank test examined differences between pre and post test measures, and Mann-Whitney U examined between group differences using SPSS 11.00 ($p \leq .05$). **Results:** Women in the training group had significant improvements in aerobic

capacity (p=<.001), resting heart rate (p=.014), body mass (p=.002), and body mass index (BMI) (p=.003). Differences between groups were significant for aerobic fitness (p<.001), body mass (p=.037), and BMI (p=.048), but not for resting heart rate (p=.053). **Conclusions:** Middle aged women participating in regular aerobic exercise training demonstrated significant improvements in physiologic and anthropometric measures. As the sample size was small and serum measures had moderate to small effects sizes, a larger sample of 100 subjects in each group is required for further analysis of changes in serum measures. **Clinical Relevance:** Study results suggest that women who regularly performed aerobic exercise as part of a nine month worksite wellness program demonstrated significant improvements in physiological and anthropometric measures compared to non-exercising women. Further study is recommended using larger samples particularly for serum measures where effect sizes were small to moderate.

THE EFFECT OF BODY POSITION ON MAXIMUM INSPIRATORY AND EXPIRATORY PRESSURES AND FORCED EXPIRATORY FLOW.

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Purpose/Hypothesis: The lungs are free to move within the chest wall and, therefore, susceptible to internal and external forces. For example, the gravitational effects resulting from changes in body position modify the resting alignment of the diaphragm and abdominal contents, alter resistance imposed on muscles, and vary ventilation/perfusion relationships. The purpose of this study was to examine the effect of different body positions on the ability of the lungs to forcefully inhale and exhale. More specifically, the purpose of this study was to compare forced vital capacity (FVC), forced expiratory volume in one second as a percent of forced vital capacity (FEV1/FVC%), maximum inspiratory pressure (MIP), and maximum expiratory pressure (MEP) values obtained during standing, sitting, forward sitting, supine, and prone positions. **Number of Subjects:** Twenty healthy subjects (8 men and 12 women 25 ± 2.96 years of age) volunteered to participate in this study. Inclusion criteria consisted of: classification of low to moderate risk according to the American College of Sports Medicine ranking criteria, no history of past or present orthopedic injury or trunk scarring that prevented or limited chest movements, and no known neurological disease. **Materials/Methods:** Subjects' maximum inspiratory pressure (MIP) and maximum expiratory pressure (MEP) were measured using a Micro Direct MicroRPM Respiratory Pressure Meter (Lewiston, ME). Forced vital capacity (FVC) and forced expiratory volume in one second as a percent of forced vital capacity (FEV1/FVC%) were measured using the MedGraphics CPFS/DTM USB Spirometer (St. Paul, MN). Measurements were obtained in random order with subjects in standing, sitting, forward sitting, supine, and prone positions. **Results:** A repeated measures one-way ANOVA revealed no significant effect of position on MIP, MEP, and FEV1/FVC%. However, FVC was affected by position ($p \leq 0.05$). Follow up paired t-tests indicated the forced vital capacity in the supine position was significantly less than in the sitting, forward sitting, and standing positions and forced vital capacity in prone was less than in the sitting and standing positions ($p \leq 0.005$). **Conclusions:** Results indicate body position does not affect the ability to generate inspiratory and expiratory pressures. However, horizontal positions such as supine and prone do result in decreased forced vital capacities. It appears the gravitational effects on thoracic and abdominal structures as well as potential restrictions imposed by contact with the table surface impact this movement. **Clinical Relevance:** Patients with already decreased lung volumes secondary to pathology may experience increased ventilation problems when in supine and prone positions. Patients and health care workers should be educated and encouraged to utilize more upright positions to improve lung mechanics.

ENDOTRACHEAL SUCTIONING AND SALINE INSTILLATION: A SYSTEMATIC REVIEW OF THE LITERATURE.

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Purpose/Hypothesis: Physical therapists (PTs) in various settings (e.g., ICU, rehab, and home health) use endotracheal suctioning (ETS) as an airway clearance technique. Saline instillation into the endotracheal or tracheostomy tube prior to ETS is commonly used as it is thought to help loosen mucus from the tracheal wall so that more can be removed during the suctioning procedure. Despite the common usage of saline instillation during ETS by PTs, as well as nurses and respiratory therapists, some investigators have questioned its benefit and have even suggested that it is harmful. The purpose of this systematic review is to summarize the research related to saline instillation during ETS. **Number of Subjects:** A broad-based PubMed search ((“Intubation, Intratracheal”[Mesh] OR “Intubation, Intratracheal/methods”[Mesh]) AND (“Sodium Chloride”[Mesh] OR (“Sodium Chloride/administration and dosage”[Mesh] OR “Sodium Chloride/standards”[Mesh])) returned 108 citations related to endotracheal saline instillation. **Materials/Methods:** Two experienced clinicians reviewed the title and/or abstract (if present) of these 108 citations, and narrowed the list to 28 relevant human or animal studies. 12 of these were either reviews or letters to the editor, leaving 16 prospective experimental trials. Data that were extracted from the manuscripts conducted by several investigators included: human vs. animal, care setting, sample size, patient characteristics, study type, intervention details, and outcome measures. **Results:** Due to the lack of consistency in outcome measures, a meta-analysis could not be conducted. None of the relevant studies reported an increase in sputum quantity obtained from the use of saline instillation. Adverse outcomes included short-term

changes in oxygenation, heart rate, blood pressure, airway resistance and dyspnea, as well as the potential for lower airway contamination. **Conclusions:** There is insufficient evidence within the scientific literature to support the use of saline instillation prior to ETS. However, there is significant evidence of short-term detrimental effects without apparent long-term adverse consequences. **Clinical Relevance:** Use of saline instillation prior to ETS as an airway clearance adjunct should be discouraged.

BLOOD LACTATE RESPONSE DURING MAXIMAL EXERCISE IN PARKINSON'S DISEASE ON AND OFF MEDICATION.

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Purpose/Hypothesis: Plasma blood lactate concentrations (BL) during exercise reflect a balance between production and utilization. As V02 increases due to increasing exercise intensity, there is a corresponding increase in BL and norepinephrine (NE). BL is an indicator of anaerobic glycolysis and at the highest points of intense exercise there is a spike in blood lactate due to changes in ventilation and the shift to anaerobic metabolism. There is evidence that there is a relationship between NE and BL during exercise. NE levels rise as exercise intensity increases. Plasma catecholamines such as NE directly increase the BL concentration. Individuals with PD present with lower NE levels which may cause lower BL responses during exercise. The purpose of this study was to observe how lower NE levels affect BL responses during maximal exercise both on and off medication to see if medication influences this relationship. **Number of Subjects:** Fourteen with PD (Hoehn and Yahr Stage 2) and 15 healthy controls (HC) without PD. **Materials/Methods:** Participants underwent a maximal exercise treadmill test. Subjects with PD performed the test once off medication (PD-Off) and then one week later on medication (PD-On). VO2 and NE levels were taken at rest and at peak exercise. Mixed model 2 x 2 ANOVAs (Group x test time) were used to compare the PD group (either PD-Off or PD-On) with the HC group at rest and peak exercise. Repeated measures 2 x 2 ANOVAs (Group x test time) were used to compare the PD-On with the PD-Off group. Tukey's post hoc tests were used to compare means when the interaction effect was significant. **Results:** At rest, VO2 measures were similar ($p>0.05$), while BL and NE levels were lower for the PD-On-med and PD-Off-med group as compared to the HC ($p<0.05$). In response to exercise, all measures increased from resting values ($p<0.05$). At peak exercise BL and NE values for the PD-On-med and PD-Off-med group were all significantly lower than HC ($p<0.05$) while VO2 was similar ($p>0.05$). PD-On group exercised to the same time as the PD-off group, however both groups attained the same V02 in less time than HC. **Conclusions:** BL and NE levels were lower in those with PD both at rest and peak exercise regardless of medication state. Although a similar V02 was attained in all groups, maximum exercise was attained quicker in the PD groups. Whether or not lower BL was related to less exercise time, thus less skeletal muscle BL produced, is not able to be determined from this experiment. Lower NE levels seem to impact on BL concentrations in PD during acute exercise. The use of BL as a tool for assessing exercise thresholds in this population would not be appropriate. **Clinical Relevance:** As with heart rate and blood pressure, NE and BL response to exercise is suppressed. Recognition that this population does not fit normal guidelines for exercise responses regardless of medication state allows for educated choices regarding exercise testing, interpretation and prescription.

PHYSIOLOGICAL EFFECTS OF NORDIC WALKING VERSUS REGULAR FAST WALKING ON HEALTHY ADULTS: A PILOT STUDY.

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Purpose/Hypothesis: The purpose of this study was to compare the physiological effects of Nordic Walking versus Regular Fast Walking on healthy adults. The hypothesis was that Nordic Walking would increase heart rate (HR), blood pressure (BP), oxygen consumption, carbon dioxide production, respiratory rate (RR) and caloric expenditure, with no increase in rate of perceived exertion (RPE) when compared to Regular Fast Walking. **Number of Subjects:** The sample of convenience consisted of sixteen healthy men (12.5%) and women (87.5%) volunteer subjects. The mean age of subjects was 25.0 (s=4.5) years with a mean body mass index (BMI) of 23.0 (s=5.4). **Materials/Methods:** The research design was a Pretest-Posttest, non-randomized, two group design. Each subject served as their own match. Subjects completed two 12-minute walking trials on a controlled environment walking course; Trial 1, Regular Fast Walking and Trial 2, Nordic Walking. Subjects received standardized instructions. Each variable was measured by the same tester. A metabolic cart was used to measure physiological variables and Borg's Rating of Perceived Exertion Scale was used to assessed RPE. **Results:** Descriptive statistics summarized demographic characteristics of the sample and physiological variable data. Paired t-Tests were used to investigate differences between Trial 1 and Trial 2 pretest and posttest change scores for each physiological variable. The Wilcoxon Signed Rank test was used to compare RPE between the two trials. Statistically significant differences (alpha = 0.05) were found between trials for HR ($p=0.00009$) and RR ($p=-0.045$), the Nordic Walking group exhibiting higher values. No significant differences between groups were found for BP (systolic; $p=0.397$, diastolic; $p=0.146$), oxygen consumption ($p=0.149$), carbon dioxide production ($p=0.290$), caloric expenditure ($p=0.128$), or RPE ($p=0.550$). **Conclusions:** Nordic Walking compared to Regular Fast Walking effected a significant increase in HR and RR without a corresponding significant increase in RPE.

Although caloric expenditure was not significantly different between trials, the mean for the Nordic Walking group was greater than that of the Regular Fast Walking group. This suggests that as a form of aerobic exercise, Nordic Walking may be more beneficial than regular Fast Walking and that Nordic Walkers perceive less physical exertion than Regular Fast Walkers. Specifically, Nordic Walking appears to be an advantageous form of physical activity for young healthy persons and further research is warranted with other populations and outcome measures. **Clinical Relevance:** Physical Therapists, the acknowledged experts on exercise, increasingly consult and prescribe exercise for wellness and prevention. The health benefits of walking are well documented, however, there is a paucity of research on Nordic Walking. When compared to walking, Nordic Walking offers additional benefits of upper body muscle recruitment, reduced force through the lower extremities and assistance with balance, and thus may be a preferred form of exercise for some populations.

CARDIOVASCULAR RESPONSES TO DIFFERENT TIMES OF WALK USING STANDARD WALKER AND/OR PLATFORM WALKER WITH WHEELS IN NON WEIGHT BEARING INDIVIDUALS.

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Purpose/Hypothesis: The purpose of this study was to examine the cardiovascular responses to different times of walk using standard walker and/or platform walker with wheels in a non weight bearing individuals. **Number of Subjects:** The study consisted of two phases using male and female physical therapy students, n=16 for Phase I and n = 14 for Phase II. The ages of the subjects range from 22 to 32 years. **Materials/Methods:** Each phase consisted of two parts. Phase I part I consisted of the participants ambulating with a standard walker (SW) and a platform walker with wheels (PWW) for 2 minutes looking at the differences in heart rate (HR), respiratory rate (RR), and blood pressure (BP) (before and after walk). Part II consisted of the same participants and same vital sign measures but they ambulate for 4 minutes. Phase II part I consisted of the participants ambulating with a SW and a PWW for 6 minutes and part II of Phase II, the same participants ambulated for 12 minutes instead of 6 minutes. The vital signs measured in Phase I were also measured in both times of walk in Phase II. In each phase, the participants ambulated with non weight bearing on one foot and they ambulated at a self selected pace. Slide Write graphic software was used to produce graphical representations of the results. Analysis of variance was used to determine the statistical significance and a confidence interval of 95% or a p value <0.05 was considered significant. **Results:** Results indicated that Phase I ambulation for 2 or 4 minutes produced no statistically significant difference between before & after measurements of HR, SBP, and RR for SW and PWW. On the other hand, Phase II results indicated that ambulation for 6 or 12 minutes produced a statistically significant difference between before and after measurements of HR, SBP, and RR for SW and PWW and DBP for RW for 12 min ($p<0.05$). The remaining DBP differences were not significant ($p>0.05$). There were no significant differences in the DBP in the 6 and 12 minutes walks for SW & platform walker with wheels. **Conclusions:** In conclusion, our study suggests that ambulation using any of the gait devices in 2 or 4 minutes walks did not significantly increase the vital signs. On the other hand, there were extra cardiovascular demands on the subjects evidenced with the significant increase in the vital signs with any of the devices in 6 or 12 minutes walks. **Clinical Relevance:** Extra precaution is needed when a patient is ambulating for up to 6 or 12 minutes with either of the gait devices especially in patients with much co-morbidity or at acute stage of a trauma as these time periods increased cardiovascular vital signs. The result shows that titration of times of walk starting at 2 or 4 minutes may be safer for some patients who are at risk of cardiovascular disease.

CARDIOVASCULAR & PULMONARY SECTION
CSM 2010
EDUCATIONAL PROGRAMMING

THURSDAY -- FEB 18

10:30- 12:30

TITLE: Feasibility of the Nintendo Wii™ for Improving Aerobic Capacity and Cardio-respiratory Function to Enhance Community Engagement

AUTHORS/INSTITUTIONS: D.M. Hayes, C.A. Miller, T.L. Millard, Physical Therapy, North Georgia College and State University, Dahlonega, GA.

DESCRIPTION: Improving aerobic capacity and cardiorespiratory function in individuals with physical disability present a challenge for physical therapists. Equipment complexity and poor adaptability lead to low participation in many traditional aerobic activities by persons with disability. Lack of aerobic activity participation lessens the ability to improve or maintain sufficient cardiorespiratory function necessary for every day activities and productive community engagement. Additionally measurement options commonly used such as vital signs are limiting and do not correlate with actual oxygen consumption or energy use during physical activity. Alternative methods for measuring functional reserve and quantifying aerobic intensity during activity in persons with disability are available and need to be further explored. The purpose of this course is to illustrate the effectiveness of using gaming technology, Nintendo Wii™ Sports and Wii™ Fit programs, for promoting improved functional aerobic reserve across the lifespan. Quantification of aerobic intensity during use of interactive video game activity will be presented. Additionally a pediatric and geriatric case study will provide a forum for discussion about using the Nintendo Wii™ interactive gaming as an effective physical therapy intervention for improving dynamic balance, economy of movement, and cardiorespiratory function.

12:30- 2:30

TITLE: Sternal Precautions – What Do They Mean?

AUTHORS/INSTITUTIONS: L.P. Cahalin, Physical Therapy, Northeastern University, Boston, MA; T. Kinney LaPier, Physical Therapy, Eastern Washington University, Spokane, WA; D.K. Shaw, Physical Therapy, Midwestern University, Glendale, AZ.

DESCRIPTION: The purposes of this course are to provide the audience with an overview of the (1) surgical procedures used during a median sternotomy, (2) potential sternotomy complications and associated risk factors, (3) history of sternal precautions, (4) current practice of sternal precautions, (5) effect of a sternotomy on function and quality of life, and (6) role of the physical therapist in sternal precautions. An open forum discussion will end the course during which an exchange of information between the audience and speakers will be provided.

2:30- 3:30

2010 Linda Crane Memorial Lecture

Striving for Excellence – Sherrill H. Hayes, PT, PhD, Professor and Chair, Department of Physical Therapy, Miller School of Medicine, University of Miami, Coral Gables, FL 33146

Historically, past McMillan Lecturers have challenged us to define excellence in Physical Therapy academic programs. While some have addressed "environmental excellence," there are other qualities like "institutional sagas" and "stories" that help create a unique and lasting bond between the faculty and their students, inspiring a legacy of belonging and lasting commitment. Building upon those qualities of a saga: loyalty and a credible story of uncommon effort and achievement, and juxtaposing these with Dr. Crane and her life, a vision of excellence in physical therapy educational programs will be explored.

FRIDAY -- FEB 19

8:00- 11:00: Research Platforms

1:00- 3:00: Research Platforms

TITLE: Pulmonary Rehabilitation: How to Set up a Program According to National Guidelines

AUTHORS/INSTITUTIONS: E. Hillegass, Cardiopulmonary Specialists, Inc., Dunwoody, GA; Department of PT, North Georgia College and State University, Dahlonega, GA; R. Crouch, Physical Therapy, Duke University, Durham, NC.

DESCRIPTION: This program will provide information for setting up a pulmonary rehabilitation program based on the current National Coverage Determination for Pulmonary Rehabilitation (January 2010). Program components, appropriate criteria for patient referral, staff roles, outcome measures and reimbursement will be discussed. This program is especially important and timely as the new national coverage guidelines will be implemented January 2010.

1:00- 3:00

TITLE: Endurance in the Rehab Population: Assessment, Intervention, and Outcome Measures

AUTHORS/INSTITUTIONS: P. Bartlo, Physical Therapy, D'Youville College, Buffalo, NY; A. Jocoy, Physical Therapy, Erie County Medical Center, Buffalo, NY.

DESCRIPTION: Endurance is a key impairment seen in the adult neurological rehabilitation population. Impairments in cardiorespiratory endurance will affect activity tolerance,

rehabilitation participation, and patient function. As integral parts of the rehab team, physical therapists and physical therapist assistants must address issues of endurance assessment, intervention, and measurement of outcomes. This session will guide the therapist through the utilization of appropriate standardized tests, as well as general interventions for endurance. Measurement of endurance outcomes will also be presented. The primary patient populations for this session will be spinal cord injury (SCI), traumatic brain injury (TBI), and stroke. Some minor information will be presented in regards to patients with multiple sclerosis and post-polio syndrome.

4:00- 6:00

TITLE: Cardiovascular and Pulmonary Research Update - Two Years (2008 & 2009) in Review.

AUTHORS/INSTITUTIONS: L.P. Cahalin, Physical Therapy, Northeastern University, Boston, MA.

DESCRIPTION: An interactive review of cardiovascular and pulmonary research published in 2008 and 2009 which has clinical implications for physical therapy examination and management. The review will focus on the methods and results of the reviewed literature to facilitate a better understanding of the results as presented by the original authors in their tables and figures.

6:00- 9:00: *Cardiovascular & Pulmonary Section Membership Meeting*

SATURDAY -- FEB 20

8:00 - 11:00

TITLE: Quitters are Winners - The Role of PTs in Smoking Cessation

AUTHORS/INSTITUTIONS D. Frownfelter, PT, DPT, MA, CCS, RRT, FCCP (Roselind Franklin University, North Chicago, IL); P.J. Ohtake, PT, PhD (SUNY Buffalo, Buffalo, NY).

DESCRIPTION: Physical therapists commonly work with individuals of all ages who use tobacco. Smoking is an independent risk factor for cardiovascular /respiratory diseases, cancers, diabetes and impairs healing thus slowing the resolution of many musculoskeletal injuries. This course will examine the impact of tobacco use on conditions that are commonly managed by physical therapists and the importance for physical therapists to actively advocate smoking cessation. Use of the evidence-based, nationally recognized 5 A's approach to smoking cessation will be described, and tips for implementation in both clinical practice and PT curricula will be shared. The session will conclude with an opportunity for participants to explore their personal barriers to engaging in smoking cessation dialogue with patients through open discussion with a seasoned smoking cessation counselor. Upon completion of this course, you'll be able to: 1) Explain the impact of tobacco use on healing and health across the lifespan. 2) Apply the 5's program, the Ask, Advice, Refer program, and the Ask and Act program. 3) Discuss the effectiveness of different nicotine replacement therapies, behavioral counseling, and combination treatments for smoking cessation. 4) Use effective communication strategies when providing smoking cessation counseling. 5) Identify web based resources for smoking cessation.

1:00- 3:00

TITLE: A Systematic Evaluation of Endurance Impairments: The Reversible and Irreversible Components

AUTHORS/INSTITUTIONS: K.J. Dias, Physical Therapy, Maryville University of St Louis, St Louis, MO; S. Collins, Physical Therapy, University of Massachusetts, Lowell, Lowell, MA.

DESCRIPTION: Impaired endurance is a primary cause of reduced activity and participation in patients with cardiopulmonary diseases. Endurance emerges from complex multi system interaction for the sustained transfer of chemical to mechanical energy required for all work demands. Impaired endurance has many etiologies and results in an inability to sustain work for a requisite period of time to achieve necessary goals. Central impairments of the cardiovascular and pulmonary systems along with peripheral skeletal muscle impairments lead to overall deficits in oxygen delivery and interact with a concomitant reduction in endurance. Skeletal muscle weakness from deconditioning and atrophy may be considered the largest reversible component of compromised endurance within the burgeoning population of individuals with chronic medical conditions. This course provides clinicians with practical examination techniques for measuring central and peripheral components of endurance caused by cardiac pump dysfunction or failure, pulmonary pump dysfunction (hyperinflation) or failure and skeletal muscle impairments. Clinicians will be guided through an evaluation process in recognizing the individual and integrated use of information collected from the examination tests and measures of endurance components. Participants will be challenged to synthesize the reversible and irreversible components of endurance in creating effective treatment interventions and an appropriate prognosis for given patient scenarios.

PRECONFERENCE COURSE AT COMBINED SECTIONS MEETING

Title: Early Mobility and Walking Program in the ICU

DESCRIPTION:
Physical Therapists working with patients in the ICU face complex challenges due to limited patient mobility due to life support, monitoring equipment, multiple medical problems, and muscle weakness. Selected patients in the ICU benefit from an early mobility and walking program to optimize cardiopulmonary and neuromuscular status. Early mobility can lead to an increase in the patient's quality of life, higher functional capability, and also potentially reduce length of hospital stay with overall reduced costs. This course will guide clinicians through the process of managing mobility issues in adult patients in the ICU. Case reports will be presented to demonstrate how the early mobility and walking program can positively impact the recovery of selected patients in ICU.

OBJECTIVES
Upon completion of this course, you will be able to:
1.Identify basic equipment, lines, and tubes used in the ICU.
2.Identify basic modes of ventilation and ventilator settings.
3.Identify ICU patients who would benefit from early mobility and walking using clinical decision making skills.
4.Understand the importance of function oriented goals for ICU patients.
5.Identify the role of multidisciplinary team members in the management of critical care patients.

Presenter:
Christiane Perme, PT, CCS

Date:
Wednesday, February 17, 2010
8 :00 am to 6:00 pm

Registration information:
Register through APTA online, mail or via phone

Contact:
Jennifer M Ryan, Education Chair
RUSHPTJEN@AOL.COM

Pricing:

	Early Bird (by 12/23/2009)	Advance (by 1/20/10)
PT Section Member	$225.00	$250.00
PTA Section Member	$200.00	$225.00
APTA PT Non-Section Member	$275.00	$300.00
APTA PTA Non-Section Member	$ 250.00	$275.00
Non-Member	$300.00	$325.00
Section Student Member	$150.00	$175.00
APTA Student Member	$175.00	$200.00
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Call for Authors

Attention Potential Authors: Consider Contributing a Special Feature!

Special Features of the *Cardiopulmonary Physical Therapy Journal*

Special features, such as Outcomes Measures, Editorials, Case Reports, Commentaries, Clinical Reminders and Special Sections are published after review by the Features Editor and, when appropriate, by one or more reviewers. Individuals who wish to contribute any of these features should send a written proposal to the Features Editor (sscherer@regis.edu) BEFORE completion and submission of the manuscript. This proposal should include a description of the scope of the intended article, an outline and the novel aspects of the intended article. Please note that feature articles must conform to the general guidelines for all manuscripts.

Outcomes Measures: Reviews of outcome measures relevant to cardiovascular and/or pulmonary physical therapy practice should be written following the outline provided in the following article:

> Scherer S, Wilson CR. Revisiting outcomes assessment. *Cardiopulmonary Physical Therapy Journal*. 2007;18:21-24.

Outcome measurement articles are usually peer-reviewed.

Editorials: While most of our editorials are commissioned to relate to papers appearing in the journal, we also welcome editorials that deal with important topics on which the author would like to express an opinion, i.e. 'hot' topics. Maximum 1000 words and 15 references.

Case Reports: Clinically interesting cases should be written in a maximum of 600 words (plus 125 word abstract) with no more than 1 figure or table and maximum of 10 references. Case reports should be of conditions that provide new insight, describe rare but modifiable disorders or present new treatments or understanding. Case reports are usually peer-reviewed.

Commentary: Commentaries include debate articles, long comments or personal observations on current research or trends in cardiovascular or pulmonary physical therapy and rehabilitation that is likely to be of interest to the readers. Maximum 1500 words, 15 references and 1 table or figure.

Letters to the Editor: We welcome lively, provocative, stimulating and amusing letters on general points of interest, as well as comments on and criticisms of articles previously published in the journal. Letters should be double spaced and signed. Please email an electronic copy of your letter. We will try to publish it as quickly as possible. Maximum 450 words, 5 references and 1 table or figure.

Clinical Reminders: Very short and simple resumes of Case Reports that are not unusual enough to be published in full, but are still useful messages that could be of use to the readers. Clinical Reminders should be of no more than 150 words, 1 small table or figure and 3 references. They do not contain abstracts.

Call for Nominations

Linda Crane Memorial Lecture Award

History
Dr. Linda Crane was a dedicated member of the profession of physical therapy since 1970, and was someone who helped to create a significant part of the Cardiovascular and Pulmonary Section's history. She was one of the first three APTA board certified clinical specialists in cardiopulmonary physical therapy (awarded in 1985), and was awarded the Lucy Blair Service Award for distinguished service to the profession in 1992. In the early years of the Cardiopulmonary Section she served as Program Chair, Chairman of the Section (1982-86), and Delegate to the House of Delegates.

Linda's clinical practice specialty was in the area of pediatric cardiopulmonary physical therapy, and she was a dedicated educator as well, having served on the faculties of University of Connecticut, University of Alabama at Birmingham, University of New England, and the University of Miami.

Dr. Crane died on March 24, 1999 after a lengthy battle with metastatic breast cancer.

Purpose
To acknowledge an individual who has made outstanding and enduring contributions to the practice of physical therapy as exemplified in the professional career of Linda Crane.

Eligibility
Nominees for the award must:
1. be a member of the APTA;
2. be a member of the Cardiovascular and Pulmonary, Education, **or** Pediatrics Section;
3. have demonstrated excellence/expertise in either clinical practice, academic practice, or in the area of research;
4. have demonstrated contributions to the Association through State, Section, or National involvement.

Nature of Award
1. The recipient will receive a commemorative plaque which will be presented at the lecture ceremony.
2. The Linda Crane Lecture will be published in the *Cardiopulmonary Physical Therapy Journal* following the lecture.

Procedure for Nomination
1. Please submit nominations on the nominating form (available through the Cardiovascular and Pulmonary, Education, and Pediatrics Sections' Web sites, or from the Nominating Committee).
2. Nominees will be contacted for additional information, including a CV and names of potential references.
3. Send materials to the Awards Committee Chairperson, as listed on the nomination form by November 1st of each year.

For additional information or to submit a nomination, please contact:

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Instructions for Authors

GENERAL INFORMATION

CARDIOPULMONARY PHYSICAL THERAPY JOURNAL is the official journal of the Cardiovascular and Pulmonary Section of the American Physical Therapy Association. Manuscripts and other works submitted for review and publication should contribute to the science and practice of physical therapy as they relate to cardiovascular and pulmonary practice or medicine. A primary purpose of the *Journal* is to present responsible, reliable, and up-to-date information that is of significant scientific and/or clinical value in the fields of cardiovascular and pulmonary evaluation and rehabilitation. The Editor-in-Chief reserves the right to return, without review, any manuscript that does not meet *Journa*l criteria. The Editorial Board adheres to the "Uniform Requirements for Manuscripts" submitted to biomedical journals. Those requirements can be accessed at **http://www.icmje.org**. All materials accepted for review are privileged communications. Author identity is blinded from reviewers and all correspondence is sent to the first author named on the manuscript, unless otherwise requested.

Articles are received with the understanding that the manuscript is an original work that has not been previously published, nor is it under consideration by another publication. Authors who submit a manuscript that contain substantially similar content that has been published or is currently being considered elsewhere for publication, must inform the Editor-in-Chief and provide her with the a copy of the other article. The Editor-in-Chief will make the determination of the duplicative nature of the submitted manuscript and may decide that the submitted manuscript is unacceptable for publication in the *Cardiopulmonary Physical Therapy Journal*. Manuscripts should be submitted electronically with the manuscript preferably in one Microsoft Word file (version 2007 preferred). In addition, the cover letter and any permission to reprint should be included in separate files.

Email submission materials to :

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MANUSCRIPT CATEGORIES

In order for a manuscript to be considered for review, it must fit into one of the following categories:

Research Report includes any original research study with an experimental, quasi-experimental, or non-experimental design. Pilot studies that add to the current body of knowledge in cardiovascular or pulmonary physical therapy will be considered as well.

Case Report focuses on a patient or group of patients and describes an element of cardiovascular or pulmonary physical therapy practice, which has not been previously documented in the literature.

Clinical Perspective is a scholarly paper that expounds on a specific approach to patient care. The paper may provide a theoretical or practical basis for practice or address professional issues in cardiovascular or pulmonary physical therapy. Authors may nominate themselves through communication with the Editor-in-Chief. References are required to support the opinion included in the paper.

Literature Review is a critical analysis of literature on a specific topic of interest related to cardiovascular or pulmonary physical therapy. Authors may nominate themselves through communication with the Editor.

PREPARATION OF MANUSCRIPTS

Authors should consult the latest edition of the American Medical Association (AMA) *Manual of Style*, 10th ed. (Available from Lippincott, Williams, & Wilkins, Customer Service, PO Box 1600, Hagerstown, MD 21740-1600, USA) The manual includes details of acceptable style and format, and specifics of manuscript preparation and submission.

Manuscripts electronic files should be double-spaced with 1-inch margins on sides, top, and bottom. The following sections should be on a separate page: title page, abstract with 2-3 keywords, text, acknowledgments, references, individual tables, figure legends, and appendices. Number pages consecutively, beginning with the title page. For purposes of more objective reviewing, do not include the primary author's name on each page. Publication may be delayed if manuscripts do not follow the recommended guidelines.

ORGANIZATION OF MANUSCRIPTS

Title page: Title page should include title of the manuscript, author name(s), affiliation of author(s), highest academic degree, and a footnote indicating a corresponding address for use by readers (e.g., This footnote should begin with the words: "Address correspondence to:").

Abstract: The abstract should be double-spaced and written in 200 words or less. Abstracts for research papers should be structured and include following headings: Purpose, Methods, Results, and Conclusions. Abstracts for other papers should include Purpose, Summary of Key Points, and a Statement of Conclusions or Recommendations. Include 2-3 key words.

Text: Double-space the copy and organize with side headings including: Introduction and Purpose, Methods, Results, Discussion and Conclusions. Use additional headings to assist reader in understanding the organization of the content.

Acknowledgements: All references to grant support should be included here. Other acknowledgments are optional.

References: Indicate references by superscripts, numbered consecutively, in the text, tables, and legends. The reference list should be numbered consecutively and presented on a separate sheet after the text. Follow the instructions in the AMA Manual of Style, and double-space throughout. Use abbreviations for journals that reflect current practice in Index Medicus.

Tables: Tables should appear following the References with each table on a separate page.. Title all tables and number them consecutively in the order of their appearance in the text.

Figures: Figures should follow references and tables (if applicable) on separate pages. Captions should be included underneath each figure. Each figure must be prepared according to the AMA *Manual of Style*, Section 2.14. Signed photographic release forms must accompany photographs of individuals.

Appendices: Number these consecutively. Use appendices for material that is not suited for figures, tables, or text, but that is essential for reader to understand the content of the manuscript.

Cover letter: Authors are expected to disclose in the cover letter any commercial associations that might pose a conflict of interest in connection with the submitted article. All funding sources supporting the work should be acknowledged in a footnote on the title page. All affiliations with or financial involvement in any organization or entity with a direct financial interest in the subject matter or material of the research discussed (e.g., employment, consultancies, stock ownership, or other equity interest, patent-licensing arrangements) should be cited in a cover letter. This information will be held in confidence by the Editor-in-Chief during the review process. If the manuscript is accepted, the Editor-in-Chief will discuss with the author(s) how best to disclose the relevant information. The cover letter must include the following statement:

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Protection of Human Subjects: The name of the Institutional Review Board that approved the research protocol must be included in the Methods section of the manuscript. Furthermore, the Methods section must contain a statement that informed consent was obtained and that the rights of the subjects were protected.

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