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Clinical Pediatric Exercise Laboratories, Reactive Balance, Sleep, and Muscle Stimulation Considerations

Teson, KM, Watson, JS, Mays, WA, Knecht, S, Curran, T, Rebovich, P, Williams, DD, Paridon, SM, White, DA. Practices and procedures in clinical pediatric exercise laboratories in North America. Pediatr Exerc Sci. 2022; Apr 7:1-8. doi: 10.1123/pes.2021-0149. Epub ahead of print. PMID: 35393371.

Despite the clinical value of exercise stress testing (EST) for the diagnosis and management of pediatric populations with cardiac and pulmonary disease, there are no standardized guidelines for clinical pediatric exercise laboratory (CPEL) in North America. Discrepancies between CPEL could hinder the evaluation of practice effectiveness and patient care. The purpose of this study was to survey CPELs in North America to determine common practices in an effort to determine the need for standardization.

Methods: CPELs, performing pediatric EST, residing in a hospital or medical center in the United States or Canada, were electronically surveyed regarding current practices, policies, and procedures. The survey contained a range of filter and contingency questions (37-68 questions) aimed at determining staffing, EST outcomes (volumes reporting and interpretation), and EST procedure and protocols. Additionally, descriptive data were obtained to evaluate inclusion criteria.

Results: Of the 73 CPEL responses received, 55 were eligible for inclusion in the study. The majority of CPELs (51; 92.7%) were located in the United States, while the remaining 4 (7.3%) were in Canada. Staffing outcomes revealed 56.3% of CPEL facilities had exercise physiologists (ExPs) (mean = *2.19; ± 1.74*) on staff, with 54.5% of those facilities primarily using an ExP to perform exercise testing, while physicians and nurses were used 30.9% and 20.0%, respectively. EST volume was reported by 26 CPELs, with ESTs per year significantly (*P = 0.0019*) higher in facilities with ExP on staff (n = 18, median EST per year = 550, interquartile range = 417, 929) as compared to facilities without an ExP on staff (n = 8, median EST per year = 200.5, interquartile range = 62.5, 301.5). CPEL procedure and protocol data determined cardiopulmonary ESTs were performed on all patients at 44% of facilities, whereas 71% of facilities completed cardiopulmonary EST following a physician request. Eighty percent of cardiopulmonary ESTs were performed on a treadmill followed by cycle ergometer (10%). Blood pressure was reportedly assessed manually (42.6%), automated (22.2%), manually and automated (29.6%), or not at all (5.6%). Pre-exercise and postexercise pulmonary function testing was reportedly completed at 85.5% of CPELs; however, variability existed with regard to postexercise timing, with 5, 10, and 15 minutes being the most common. Despite 78% of CPELs possessing a manual for standard operating procedures, only 37.5% of CPELs indicated practicing/conducting mock emergency procedures in the previous 12 months.

Discussion: The current study sought to evaluate the staffing and EST procedures, protocols, and volumes of CPELs in North America. Previous research has supported the efficacy of EST for diagnosis and medical management of pediatric populations with cardiac and pulmonary disease. The current study informs readers regarding the CPEL operational commonalities and discrepancies that exist. Similarly, greater than 90% of CPELs included cardiopulmonary stress testing, while pulmonary function and stress echocardiography were provided by more than 85% and 70% of CPELs, respectively. Although the majority of facilities used treadmill and cycle ergometers for testing, the protocols were quite varied. The most common treadmill protocol included the modified Bruce and Bruce protocols, while continuous ramp protocol was most common for cycle ergometer; however, approximately 20.4% of treadmill and 6.4% of cycle protocols were institution-specific, limiting standardization. Methods for assessing blood pressure were also inconsistent across CPELs. Staffing was quite broad (ExP, physician, nurse, EKG tech, respiratory therapist), yet EST annual test volumes, as well as test options and exercise physiology specialty services were highest in facilities who employed an ExP (noting that this position was performing

clinical ExP duties). According to the data presented, some similarities exist in CPEL operations, nevertheless, in an effort to advance quality, productivity, and research, continued steps should be taken to standardize CPEL staffing and practices.

Kim, Y, Vakula, MN, Bolton, DAE, Dakin, CJ, Thompson, BJ, Slocum, TA, Teramoto, M, Bressel, E. Which exercise interventions can most effectively improve reactive balance in older adults? A systematic review and network meta-analysis. Front Aging Neurosci. 2022 Jan 18;13:764826. doi: 10.3389/fnagi.2021.764826

The Centers for Disease Control in the United States reports 1 in 4 adults 65 or older experience at least 1 fall a year. Since falls increase risk of injuries and death, fall risk reduction is a clinically relevant issue. Physiological changes that occur to the sensorimotor control systems with aging inherently alter balance and increase fall risk in older adults. Numerous exercise interventions have been tested for their impact on overall balance as well as reactive balance, the ability to effectively react to mechanical disruptions to balance. The goal of the current study was to evaluate which interventions were most impactful on reactive balance measures in older adults through the use of a network meta-analysis (NMA).

Methods: Researchers used 9 electronic databases through August 2021 to screen randomized controlled trials, examining the impact of at least 1 exercise-based intervention on balance measures, including at least 1 measure of reactive balance, with adults 65 and older. Studies were excluded if they did not report details on the exercise intervention or included nonexercise interventions. An NMA was employed to evaluate data as it allowed for the both the direct comparison and indirect comparison of exercise interventions on reactive balance in a singular statistical model.

Results: Following the filtering of 7,394 records, 384 full-text articles were assessed for eligibility. While a total of 46 studies met eligibility requirements and were included for the systematic review, only 39 met requirements for the quantitative NMA analysis. The average age of the 1,745 study participants was 71.9 ± 3.9 years, the majority of which were community-dwelling healthy adults. The reactive balance was assessed preinterventions and postinterventions, but a variety of exercise interventions were used across studies, ranging in duration (1 week to 1 year) and frequency (1 to 5 sessions per week). According to the NMA matrix, the probability of improving reactive balance was highest for the single balance exercise including reactive balance component, power, and gait training including reactive balance component.

Discussion: Balance problems are an underlying risk for falls. The current NMA study evaluated the effectiveness of 17 different exercise interventions on reactive balance. The results of the current study reveal that exercise interventions including a reactive balance component are more likely to have a positive impact on reactive balance, indicating the importance of specificity of training. Additionally, the study provides evidence regarding the value of power training to improve reactive balance with older adult populations. Aging related neuromuscular alterations associated with type 2 muscle fibers reduces strength, power and rate of force development, all which play an essential role in fall risk. The results of the current study are clinically relevant as they provide some guidance regarding optimizing exercise prescription aimed at improving reactive balance, potentially reducing fall risk.

Aastebøl Frøjd, L, Dammen, T, Munkhaugen, J, Weedon-Fekjær, H, Nordhus, IH, Papageorgiou, C, Sverre, E. Insomnia as a predictor of recurrent cardiovascular events in patients with coronary heart disease. Sleep Advances. 2022; 3(1): 1-10. doi.org/10.1093/sleepadvances/zpac007

Clinical exercise physiologists are tasked with staying abreast on conditions that may contribute additional risk for clients with cardiovascular (CV) diseases. Approximately 37% to 45% of patients with coronary heart disease (CHD) suffer from insomnia, which includes a wide range of sleep-related disturbances (sleep initiation difficulty, duration, poor sleep quality) that result in impaired daytime function. Recent literature has associated insomnia with various CV risk factors, however methodological limitations including the failure to use diagnostic criteria to assess the presence of insomnia has generated conflicting data. The current study set out to determine the association between insomnia and CV events in patients with CHD.

Methods: CHD outpatients (N = 1,789) from 2 Norwegian hospitals between 18 and 80 years old with a previous coronary event (myocardial infarction and/or coronary revascularization) were assessed for eligibility. Those with cognitive impairment, psychosis, drug abuse, end of life prognosis, language barrier, and lack of availability during study duration were eliminated from the study (n = 422), leaving 1,367 eligible participants. A total of 1,082 agreed to participate and completed baseline testing, which included a comprehensive questionnaire to determine CV risk factors and medications, the completion of the Bergen Insomnia Scale to identify the presence of clinical insomnia, the Berlin Questionnaire to assess for obstructive sleep apnea, and the Hospital Anxiety and Depression Scale. Approximately 4 years later, medical records of participants (n = 1,068) were reviewed to determine recurrence of major adverse CV events (MACE).

Results: Participants consisted of males (79%) and females (21%) with an average age of 61.5 ± 10 years. Clinical insomnia, as determined by Bergen Insomnia Scale, was present in 45% of participants, and 47% were deemed high risk for obstructive sleep apnea. Additional baseline data revealed 21% and 14% presented with symptoms of anxiety

and depression, respectively. When adjusted for age, gender, and previous CV events, clinical insomnia was significantly associated with MACE, relative risk of 1.62 (95% confidence interval [CI]: 1.24, 2.11, $P < 0.001$). Adjustments for CV risk factors, CV comorbidities, and Hospital Anxiety and Depression Scale maintained significant associations between clinical insomnia and MACE with relative risk of 1.49 (95% CI: 1.14, 1.97, $P = 0.004$), 1.48 (95% CI: 1.12, 1.96, $P = 0.006$), and 1.41 (95% CI: 1.05, 1.89, $P = 0.023$), respectively. Obstructive sleep apnea risk however was not associated with MACE ($P = 0.170$). Analyses determined 16% (95% CI: 4%, 26%, $P = 0.007$) of MACE was attributable to clinical insomnia.

Discussion: Insomnia is the most common sleep disorder, and prevalence is higher in individuals with CHD compared to the general population. This is concerning considering the results of the current study that indicate an increased risk of MACE in CHD patients with clinical insomnia. Insomnia was identified as the third strongest attributable risk factor, behind smoking history and physical inactivity, for predicting recurrent MACE. CHD patients with an initial CV event prior to baseline and who met the criteria for clinical insomnia had a 41% to 62% increased risk for MACE. The mechanisms by which insomnia influences recurrent MACE is still unclear despite the fact that the current study adjusted for various factors (CV risk, CV comorbidities, and Hospital Anxiety and Depression Scale), therefore additional research is warranted. Regardless, determining the presence of clinical insomnia as well as effective monitoring and treatment should be carefully considered by clinical exercise physiologists working with CHD patients.

Moez RA, Hady AA, Attia FA, El Nahas NG. High tone external muscle stimulation versus aerobic exercise on endothelial dysfunction and walking parameters in peripheral arterial disease. Int. J. Thin Film Sci. Technol. 2022. 11(S1):9–14. doi.org/10.18576/ijtfst/11S102

Reduced arterial perfusion associated with advanced atherosclerosis in the lower extremities is the hallmark of peripheral arterial disease (PAD). PAD-related ischemia will subsequently result in muscle pain, known as intermitted claudication, making physical activity challenging. Diabetic populations are 3 to 4 times more likely to be diagnosed with PAD compared to the general population. Additionally, PAD is associated with complications, including foot ulcers and amputation. While exercise is effective at reducing symptoms of PAD, identifying additional noninvasive treatment methods may be helpful, considering physical activity may be limited by pain and PAD related lower limb mobility impairments. The authors of the current study evaluated the efficacy of high tone external muscle stimulation on PAD variables in diabetic patients.

Methods: Patients with diabetes and moderate PAD, based on ankle brachial pressure index (0.4-0.7), from outpatient clinics were recruited to participate, and 60 participants were randomized into 1 of 2 groups, high tone muscle stimulation (HTEMS) group or exercise group. The HTEMS group (n = 30) completed 60 min of HTEMS 3 times weekly for 12 weeks. The exercise group (n = 30) completed a 40 min moderate intensity (rate of perceived exertion 12-14) aerobic exercise program on a treadmill 3 times weekly for 12 weeks. Baseline graded treadmill testing was used to evaluate walking-related variables including claudication pain time, claudication pain distance, peak walking time, and peak walking distance. Blood samples were taken to evaluate nitric oxide levels. All variables were assessed following the completion of the 12-week interventions.

Results: Intervention groups were similar in age (HTEMS: 56 ± 6.83; Exercise: 57 ± 5.91) and had ankle brachial pressure index between 0.4 and 0.7. Significant ($P = 0.001$) pretreatment to posttreatment improvements were reported in nitric oxide for both the HTEMS and exercise groups; however, no significant difference was noted in pretreatment ($P = 0.37$) or posttreatment ($P = 0.87$) values between groups. HTEMS reportedly improved endothelial function similarly to that of exercise, 17.9% and 17.4% respectively. All walking variables (claudication pain time, claudication pain distance, peak walking time, and peak walking distance) increased significantly ($P < 0.05$) pretreatment to posttreatment for both HTEMS (108%, 95%, 90%, 96%, respectively) and exercise (113%, 102%, 91%, 99%) groups, respectively. No significant differences were found between groups for any of the walking variables, thus neither protocol appeared to be more impactful.

Discussion: PAD is a progressive condition associated with reduced oxygen delivery to the lower extremities, compromising muscle function and increasing risk of cell death. Although appropriate exercise interventions can alleviate symptoms of PAD, there are some situations where exercise may be difficult or inappropriate. Results of the current study indicate HTMES is as effective as exercise at improving PAD-related variables in diabetic patients, given that endothelial function, measured by nitric oxide levels, and walking parameters were improved significantly regardless of intervention. The current study lends support to the viability of HTEMS as a method to improve endothelial function and walking parameters in diabetic patients with PAD when exercise may be too challenging. Further research should be conducted to continue to explore the use of HTEMS in an effort to establish guidelines for effective and appropriate clinical application with PAD patients.