STANDARDIZED ADAPTED CARDIAC REHABILITATION AT AN INPATIENT REHABILITATION FACILITY

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INTRODUCTION: Inpatient rehabilitation facilities (IRFs) serve as an interim level of care for many patients with cardiac dysfunction but are not included among the three phases of cardiac rehabilitation (CR). The education on modifiable risk factors, cardiovascular exercise, and flexibility training given to patients with cardiac diseases are delivered in the acute hospital (phase I) and the outpatient setting (phase II). Our hypothesis was that adapting phase II components to this interim setting would improve outcomes and bridge the gap between phases. In this study, the feasibility of a standardized adapted CR protocol for IRFs and effect on functional outcomes was assessed. METHODS: This prospective cohort study screened 60 patients over a 6-month period. Patients with primary cardiac diagnoses were screened for inclusion. Both surgical and non-surgical candidates were included. Exclusion criteria were based on the phase II CR criteria of the American College of Sports Medicine (ACSM). Patients received continuous ECG monitoring and physician clearance prior to participation. The standardized adapted CR protocol included individual prescription for cardiopulmonary endurance exercise consistent with ACSM Phase II CR guidelines, flexibility training, and education on modifiable risk factors. Standardized outcome measures included the 6-minute walk test, Borg rating of perceived exertion scale (6-20), EQ-5D-5L quality of life measure, and Section GG (mobility) scores of the Centers for Medicare & Medicaid Services Inpatient Rehabilitation Facility Patient Assessment Instrument. A one-month follow-up evaluated attendance to phase II CR, and quality of life (including maintenance of functional gains). Physical therapy staff were surveyed to identify limitations. RESULTS: Forty-one patients were deemed eligible to participate. Thirty-two patients participated in at least one endurance session with an average of 3 (+ 1) 20-minute sessions completed. Borg scores (14 + 1) reached the recommended range (somewhat hard to hard) during sessions. Participants demonstrated a statistically significant improvement in their GG mobility scores. Sixty-nine percent reached the 6-minute walk minimal clinically important difference (MCID), and 59% met the quality-of-life MCID, despite their short length of stay in the IRF setting (11 + 4 days). Survey results indicated short length of stay, the need to address functional goals over exercise, inability to tolerate 20 minutes of cumulative aerobic exercise, and compliance of protocol amongst therapists were limiting factors to endurance protocol adherence. Conclusions: A standardized adapted CR protocol was feasible within an IRF setting, providing targeted education, increased awareness of phase II CR options, and clear and specific guidelines for creation of individualized exercise programs. Patients demonstrated improvements in functional mobility, cardiovascular endurance, and quality of life.

INTER-RATER AGREEMENT ON ECG INTERPRETATION AMONG A CARDIOLOGIST, AN EXPERT READER

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INTRODUCTION: The use of electrocardiograms (ECGs) in preparticipation evaluations (PPE) for athletes remains a topic of debate in the United States. Over the years, athlete-specific ECG criteria have evolved, leading to greater specificity and reduced false positive rates. Recent comparisons have been made between local physicians and those from specialized centers in their consistency of ECG interpretation using the 2017 International Criteria. However, there has been limited research on whether novice ECG interpreters, such as undergraduate students, can be trained to accurately interpret athletes' ECGs using the 2017 International Criteria and further, be able to identify the abnormal condition seen on the ECG. This study aims to evaluate the overall and individual inter-rater reliability of novice ECG interpreters and exercise physiologist when compared to a cardiologist. METHODS. Three novice ECG interpreters (undergraduate exercise science students) received training in interpreting athlete ECGs using the 2017 International Criteria over the course of one semester under the guidance of an expert reader. During an annual high school sports screening event, 1,350 ECGs were collected and assigned unique identification numbers. After the screening event, three novice interpreters (students), a cardiologist, and an Exercise Physiologist (exercise science professor) independently classified the ECGs as either "normal" or "abnormal" and identified the findings on abnormal ECGs based on the International Criteria. All participants were blinded to cardiologist classifications made during the screening event. Information on the athlete's age, gender, race/ethnicity, and sport was included with the ECGs. Overall agreement between the cardiologist, exercise physiologist, and three students was assessed using a Fleiss' kappa analysis and individual pair agreement was calculated using Crosstabs. RESULTS: 1,350 athlete ECGs (males = 879; females = 471, age (mean + SD) 15.09+1.3y) were reviewed and 51 (3.8%) abnormal cases were identified and further diagnosed. The overall inter-rater agreement between a cardiologist, an exercise physiologist, and three student readers in classifying an ECG as normal or abnormal was rated as good ($k = 0.711$, $p < .001$). Individual agreement between which ECGs were classified as normal ranged from moderate, ($k = .585$) to very good ($k = .845$). Abnormal readings were further analyzed, and overall abnormal diagnosis agreement was rated as moderate ($k = .432$, $p = 0.00$) with individual agreement on abnormal diagnosis ranging from poor ($k = .196$) to very good ($k = .851$). CONCLUSION: This study demonstrated that novice ECG readers could correctly classify ECGs based on the International Criteria as “normal and abnormal” but may need further training in accurately identifying ECG abnormalities in athletes.

CHANGES IN MUSCLE OXYGENATION & MOTOR UNIT ACTIVATION IN RESISTANCE EXERCISE IN OBESE WOMEN

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BACKGROUND: The study of motor unit activation during exercise provides information on the function of the neuromuscular system and changes in muscle oxygenation for metabolic functions during exercise. The aim of this study was to examine the changes in muscle oxygenation and motor unit activation during resistance exercise and the correlation between these changes in normoweight and obese women. METHODS/ DESIGN: A total of 25 women participated who were divided, based on body fat percentage (BF), into normoweight (BF: 25.4±3.41, age: 20.7±0.89 years, n=13) and obese (BF: 40.47±6.07, age: 20.5±0.97 years, n=12) and performed in the single leg extension exercise 3 sets of 10 repetitions at 60% of 1RM with a 3' rest between sets. During the performance of the exercise, electromyographic (EMG) activity of the vastus lateralis muscle was recorded and through decomposition of the EMG signal, the amplitude of the motor unit action potential (MUAP), the firing rate (FR) was determined. Also, the change in oxygenation of the vastus lateralis muscle was recorded by near-infrared spectroscopy (NIRS) and the slope of the change in oxygenated (O2Hb) and deoxygenated (HHb) hemoglobin during the performance of the sets was calculated. RESULTS: There was a significant increase ($p<0.05$) in EMGrms activity and FR of the motor units during the performance of the sets with no difference ($p<0.05$) in the change between the two groups. The slope of increase in HHb and decrease in O2Hb was higher ($p<0.05$) in normoweight women. There was no significant correlation between the rate of change of the EMGrms signal ($r = 0.08$-0.30) and FR ($r = 0.04$-0.28) with the rate of change of O2Hb and HHb in each set either in the whole sample or in each group separately. CONCLUSIONS: In conclusion, normoweight and obese women show similar changes in neuromuscular activation during resistance exercise but different metabolic function with greater deoxygenation in normoweight women. The lack of correlation between the change in neuromuscular activation and muscle oxygenation is likely due to the increased use of anaerobic energy production mechanisms during the performance of this exercise program.

EFFECT OF PULMONARY REHABILITATION ON PATIENTS WITH DIAPHRAGMATIC EVENTRATION

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INTRODUCTION: Diaphragmatic eventration (DE) is the abnormal elevation of one part or the entire hemidiaphragm. This can be caused by lack of muscle or nerve function while maintaining its anatomical attachments. The symptomatic patients of DE usually suffer from shortness of breath while rest or during physical activity along with reduced functional capacity. Purpose: This study aims to investigate whether patients suffering from DE can derive benefits from pulmonary rehabilitation (PR) focusing on inspiratory muscle training (IMT). Design: A case series involving quasi-experimental study to test effectiveness of PR and IMT program on participants who completed six weeks of program. METHODS: Four participants with DE who underwent six weeks regimen of PR focusing on IMT were recruited. The outcome measures of this study are: level of dyspnea measured by modified medical research council (mMRC), pulmonary function test (PFT) to test lung capacity and volume by looking at forced vital capacity (FVC) and forced expiratory volume in one second (FEV1) respectively, and 6-minute walk test (6MWT) to test the functional capacity of the participants. The analysis was conducted using dependent t test to evaluate pre-post outcome measures. RESULTS: Four participants completed six weeks of PR with the focus on using IMT device. The dependent t-test for FEV1 and FVC revealed that there was a significant improvement after six weeks, $t(3) = -3.154$, $p < 0.05$, $t(3) = -2.529$, $p < 0.05$ respectively. The dyspnea scale (mMRC) showed significant improvement after six weeks $t(3) = 5.196$, $p < 0.05$. The functional capacity measured by the distance covered in 6MWT was improved significantly after six weeks $t(3) = -3.360$, $p < 0.05$. Conclusion: This study showed that pulmonary rehabilitation focusing on IMT can improve patients with DE alleviating dyspnea, as well as improving functional capacity. There might be an improvement of the pulmonary function and functional capacity of the patient without the need of surgical intervention.

EFFECTS OF CARDIAC REHABILITATION ON FUNCTIONAL CAPACITY OF HEART FAILURE PATIENTS

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INTRODUCTION: Heart failure (HF) is a progressive condition impacts not only cardiac function but also respiratory, vascular and skeletal systems. Patients often endure shortness of breath (SOB) at rest or during exertion, coupled with fatigue, resulting in a significant reduction in functional and exercise capacity. This impairment affects their ability to carry out daily activities and decrease their overall health related quality of life (QOL). Purpose: This study aims to test the effectiveness of a hospital-based cardiac rehabilitation on functional capacity of heart failure patients. Design: Pre-post intervention experimental design METHODS: Thirteen HF patients underwent 18 weeks of hospital-based cardiac rehabilitation program (CR). The CR program consisted of aerobic, strengthening, and respiratory muscle training. Functional and exercise capacity were measured pre and post CR using New York Heart Association Classification (NYHA), distance covered in 6-minute walk test (6MWT), rate of perceived exertion using Borg scale, and metabolic equivalent (METs). The analysis was conducted using dependent t test to evaluate pre-post outcome measures. RESULTS: Thirteen participants completed 18 weeks of hospital-based CR program. The dependent t-test for NYHA revealed that there was a significant improvement after 18 weeks, $t(12) = 6.743$, $p < 0.001$.The functional capacity measured by the distance covered in 6MWT was improved significantly after 18 weeks $t(12) = -6.391$, $p < 0.001$ along with METs $t(12) = -5.903$, $p < 0.001$ and Borg scale $t(12) = 12.282$, $p < 0.001$. CONCLUSIONS: This study showed that hospital-based cardiac rehabilitation can alleviate symptoms and improve functional capacity of heart failure patients. A longitudinal study is recommended to test whether these improvements will be maintained overtime.

STEPPING OUTSIDE THE BOX: TAILORING EXERCISE TEST PROTOCOLS & PROCEDURES

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INTRODUCTION: The most frequently used exercise test protocol in the United States is the Bruce treadmill protocol. Using this standard protocol enables clinicians to report clinically useful information beyond myocardial ischemia, hemodynamic response, and rhythm, such as estimating prognosis with the Duke Treadmill Score and categorizing fitness by age and sex. However, some patients, especially highly fit aerobic-type athletes, might be better served with tailored exercise test procedures. CASE PRESENTATION: A 22-year-old, apparently healthy male, collegiate track athlete complained of lightheadedness and profound fatigue after repeated intervals of 400-800 m. The referring physician ordered a cardiopulmonary exercise test in order to replicate his training regimen and symptoms. MANAGEMENT: A plan was developed to perform a graded exercise test (GXT) on a treadmill with measurement of expired air, followed by a 3-min active cooldown, then up to 4 run/walk intervals of 1- and 2-min duration, respectively. Spirometry was performed before the GXT and repeatedly up to 20 min after the last run interval. The GXT protocol was based on the athlete's self-reported pace during warmup (8:00/mile [4:58/km]) and a 10 km run (6:00/mile [3:44/km]) with a target duration of 10 min. The run intervals were based on his self-reported target time to complete 400 m (~65 s) during training. That time was converted to speed (13.8 miles/h [22.2 km/h]) and the associated metabolic equivalents of task (METs) were estimated (22 METs). Because the maximum speed of the laboratory treadmill is 12 miles/h (19.3 km/h), a 3% incline was used to achieve the target METs during the run intervals. A 12-lead ECG and pulse oximetry were monitored continuously during the GXT, the run/walk intervals, and through 6 min of recovery. Blood pressure (BP) was monitored via auscultation every 2 min through the initial 6 min of the GXT and recovery. BPs could not be obtained at higher running speeds. He did not use the handrail for support during testing. He reported that the run intervals were a similar level of exertion as during training. No abnormalities were noted during the GXT or the spirometry. His symptoms were reproduced during the 4th run interval. Total time in the laboratory was 1.5 hours. DISCUSSION: Exercise testing on this patient could have been limited to a GXT (Bruce protocol or other), but the probability of reproducing his symptoms would have been low. As a young athlete, staff were confident that he could tolerate a GXT and several running intervals during the same encounter. Knowledge of METs allowed for an equivalent workload to be identified for the intervals despite limitations of the treadmill speed. It is not uncommon for laboratories to limit testing protocols to a few options (e.g. Bruce or modified Bruce). However, it can be beneficial to tailor procedures for select patients to increase the likelihood of reproducing patient-specific complaints or responses.

CARDIOVASCULAR RESPONSES TO SINGLE- VS. MULTI-CHAMBERED BLOOD FLOW RESTRICTION CUFFS

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BACKGROUND: This study aimed to investigate the impact of the blood flow restriction bladder type (single- [SC-BFR] vs. multi-chambered [MC-BFR]) on cardiovascular responses with exercise sessions incorporating multiple sets to volitional failure in a randomized, crossover experimental design. METHODS: Twenty-seven healthy, physically active participants (11 females; age: 22.6±5.7; BMI: 25.0±4.1 kg/m2; ~93% reported regular resistance training within 6 months) randomly performed wall squats to failure (4 x sets to failure, 20% 1RM, 60% limb occlusion pressure, 1 min rest between sets) in each of three conditions: SC-BFR (using the Delfi Personalized Tourniquet Device), MC-BFR (using the BStrong Cuffs), and N-BFR (no BFR control). Hemodynamic assessments and indices of arterial stiffness were monitored immediately before and after each exercise session. RESULTS: SC-BFR blunted post-exercise increases in carotid-femoral pulse wave velocity ($p = 0.328$) whereas the other conditions showed elevations ($p < 0.05$). CONCLUSION: The bladder design of a BFR cuff impacts the acute responses to exercise, as SC-BFR mitigates post-exercise arterial stiffness responses compared to MC-BFR and N-BFR. This was the first intervention to examine the acute effects of BFR bladder design on arterial stiffness during lower body exercise. SC-BFR appears to be a safe option for lower limb occlusion training.

ASSESSING VO2 PEAK PREDICTION ACCURACY IN OLDER ADULTS IN CARDIOPULMONARY REHAB

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BACKGROUND: Peak oxygen uptake (VO2 peak) is an important measure in cardiopulmonary rehabilitation (CR), reflecting cardiovascular health and guiding treatment. Clinical exercise tests predict VO2 using the ACSM model, which may overestimate VO2 peak for older adults in CR. Age-related changes and handrail support during exercise are not considered in most equations. Foster developed a prediction equation for older adults with handrail support, but it hasn't been tested on CR patients. This study aims to evaluate the accuracy of VO2 peak prediction equations, including the ACSM equation and Foster equations (with and without handrail support), in older adults undergoing CR. METHODS: CR patients (n=11, age: 69.5 ± 10.4 yrs) underwent a treadmill test measuring VO2 peak via gas exchange analysis. Predicted VO2 peak was calculated using the ACSM equation (modified Bruce protocol) and the Foster equation (Pepper protocol, with and without handrail support). Paired t-tests compared actual and predicted VO2 peak, and effect sizes were calculated. RESULTS: The Foster model with handrail support provided the most accurate estimate of VO2 peak, but still overestimated it (Foster handrail: 18.06 ± 5.38 ml/kg/min vs. actual: 15.8 ± 6.4 ml/kg/min, p = 0.047). The ACSM model had the greatest discrepancy (ACSM: 21.27 ± 7.75 ml/kg/min vs. actual: 15.8 ± 6.4 ml/kg/min, p = 0.001), with a large effect size (Cohen's d = -1.37). CONCLUSION: The ACSM model significantly overestimated VO2 peak in CR patients, while the Foster handrail model provided the most accurate estimates, though still with some overestimation. These results emphasize the need for improved VO2 prediction models for clinical stress testing.

EFFECTS OF EXERCISE, CREATINE & COQ10 ON MUSCLE FUNCTION IN CHILDREN WITH MYOSITIS

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BACKGROUND: Juvenile idiopathic inflammatory myopathies (JIIM) are characterized by chronic inflammation of skeletal muscles, muscle weakness and skin rashes. Patients with JIIM have impaired energy metabolism which contributes to the pathophysiology of debilitating muscular symptoms. Creatine (Cr) and Coenzyme Q10 (CoQ10) supplementation, compounds involved in cellular metabolism, has been shown to improve outcomes in musculoskeletal diseases similar to JIIM. Although exercising with Cr supplementation has demonstrated improved muscle function in adults with myositis, its efficacy in children is uncertain. CoQ10 has not yet been used as a therapeutic supplement for myositis. The primary aim of this study was to evaluate whether supplementation with Cr+CoQ10, combined with an exercise program, enhances muscle function in children with juvenile idiopathic inflammatory myopathy (JIIM), as measured by the Wingate Test. Secondary objectives included assessing improvements in vertical jump height, disease activity, and quality of life (QoL), as reported by clinicians, patients, and parents through questionnaires. METHODS: We recruited 15 patients aged 8-18 from the JIIM specialty clinic at SickKids to participate in a 6-month randomized, double-blind, placebo-controlled, multiple baseline trial. Data were analyzed using a randomization test. RESULTS: The intervention group demonstrated significant mean differences in peak power (mean difference (MD) = 93.99 Watts; p = 0.0268), mean power (MD = 72.68 Watts; p = 0.0265), and minimum power (MD = 47.29 Watts; p = 0.0119) on the Wingate Test, compared to the placebo group. Additionally, a significant mean difference in vertical jump peak power (MD = 642.91 Watts; p = 0.0145) was observed favoring the intervention. However, these results were not replicated when analyzed using linear mixed models, which account for trends in data before and after the intervention. CONCLUSION: These results suggest that while the initial findings are promising, even with these significant p-values, they may be due to chance rather than a true effect of the intervention. Further research is needed to explore the impact of creatine and CoQ10 supplementation in children with JIIM.

CONGENITAL AND ACQUIRED CARDIOVASCULAR DISEASE PATIENTS' SARCOPENIA AND CPET RESPONSES

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PURPOSE: Low lean muscle mass, or sarcopenia, is common in the context of advanced cardiac dysfunction and heart failure. We conducted a retrospective study to evaluate associations between sarcopenia and cardiopulmonary exercise testing (CPET) indices in adolescent and young adult patients undergoing testing at a freestanding children's hospital. METHODS: We reviewed 1658 clinically referred CPETs with simultaneous bioimpedance analysis (BIA, InBody570, Cerritos, CA, USA) performed between 6/2020 – 10/2024. Submaximal CPETs (peak respiratory exchange ratio < 1.1) were excluded. BIA measurements included skeletal muscle mass (SMM; kg) and skeletal muscle mass indexed to height (SMI; kg/m2). Sarcopenia was defined by previously published BIA standards of SMI <7.0 kg/m2 for men and <5.5 kg/m2 for women, irrespective of age. Data is presented as median [Q1, Q3]. RESULTS: Median age was 21.5 years and 48% of patients were female. Sarcopenia was present in 8.1% of the tests (134/1524) with a SMI of 6.1 kg/m2 in the sarcopenia group vs 7.6 kg/m2 in the other group. These subjects had lower height, weight, and BSA ($p < 0.001$ for all 3), and were younger (19.7 vs 21.7 years; $p = 0.004$). Peak VO2 was lower in the sarcopenia group (1.2 [1.0, 1.5] vs 1.9 [1.5, 2.4] L/min). This difference persisted even when indexing VO2 to body mass or to BSA. SMM (kg) correlated strongly with both peak VO2 (L/min) and O2P (ml/beat) with a Pearson $R = 0.73$, $p < 0.0001$ and 0.74, $p < 0.0001$; respectively. CONCLUSION: Individuals referred for CPET who met criteria for sarcopenia had substantially worse exercise performance. The causality of this association and its implications remain to be identified. Future studies should evaluate the clinical outcomes associated with those with sarcopenia in specific heart conditions and evaluate the differences in muscle mass distribution, as assessed by BIA.

ASSOCIATIONS OF ACTIGRAPHY-ASSESSED SLEEP AND NIGHTTIME BLOOD PRESSURE IN ADULTS

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BACKGROUND: Blood pressure (BP) follows a diurnal rhythm, with higher values in the daytime and lower values at night. Those whose nocturnal systolic blood pressure (SBP) dips less than 10% of daytime values are at greater risk for adverse cardiovascular outcomes. It remains unclear whether disrupted sleep is associated with nocturnal BP dipping. PURPOSE: To examine the associations between actigraphy-assessed sleep and nocturnal BP dipping in sedentary office workers with elevated BP. METHODS: Data were collected from 172 participants (SBP= 133.8±9.8mmHg; diastolic BP [DBP]= 81.5±7.1mmHg; 60.1% female; 83.4% White; age=44.5±10.8 y; body mass index [BMI]=31.6±6.6 kg/m2). Sleep was measured using a wrist-worn Actiwatch Spectrum accelerometer concurrently with an Oscar 2 24-hour ambulatory BP monitor on up to 2 occasions per participant. BP was assessed every 30 min during the daytime and 60 min during the nocturnal period (based on participants' typical bed and wake times). The magnitude of nocturnal dip was calculated as [(daytime SBP – nighttime SBP)/daytime SBP*100]. Linear mixed models were used to examine the associations between sleep and nocturnal SBP dipping, adjusting for age, sex, BMI, race, and daytime SBP. Additional sensitivity analyses accounted for obstructive sleep apnea (OSA) severity in a subsample (n=115). RESULTS: Across 322 nights of data, participants had a nocturnal SBP=113.3±11.5 mmHg, dipping 13.7±6.5% lower than daytime SBP. Participants had a mean total sleep time (TST)=431.1±70.3 min, sleep efficiency (SE)=90.2±6.2%, wake after sleep onset (WASO)=40.9±30.4 min, and bedtime=23.2±1.2 h. For every 1% increase in SE, the magnitude of nocturnal SBP dip increased by 0.27±0.05% ($p<0.001$). Each 1-min increase in WASO, the magnitude of nocturnal SBP dip decreased by 0.05±0.01% ($p<0.001$). TST, bedtime, sleep midpoint, and sleep onset latency were not statistically significantly associated with the magnitude of nocturnal dipping (each $p>0.3$). After accounting for OSA severity, SE and WASO remained significantly associated with the magnitude of nocturnal SBP dip (each $p< 0.001$). CONCLUSION: In sedentary office workers, actigraphy-assessed SE and WASO were associated with nocturnal SBP dipping. Future studies should examine whether improving sleep enhances nighttime BP regulation.

EARLY RESISTANCE TRAINING AFTER A STERNONOMY VS TRADITIONAL PRECAUTIONS

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INTRODUCTION The “Keep Your Move In The Tube” (KYMITT) is a mindful movement model that replaces traditional sternal precautions for after open heart surgery/sternotomy patients. The conservative sternal precautions that were often used after discharge from the hospital post-sternotomy can leave patients feeling high anxiety/fear. The approach of KYMITT focuses on kinesiological movements rather than load and time restrictions. This approach can help the patient feel back to normal and independent sooner. CASE PRESENTATION A 60-year-old male who had a Coronary Artery Bypass Graft x2 (CABGx2) performed on 02/09/24 came in for cardiac rehabilitation (CR). Patient was discharged from the hospital on 02/13/24 (4 days total) and started CR on 03/01/24 (21 days post operation). The intervention for treatment used was KYMITT versus restrictive sternal precautions. First day of CR the patient was too fearful to use a treadmill for an exercise tolerance test (ETT). We tested his cardiovascular capacity with a six-minute walk test (6MWT) instead. The patient achieved 2.4 METs, and averaged about 1.9 MPH walking. The patient started weight training on day 2 of CR. Following the KYMITT protocol we let pain be his guide. We began with 5 strengthening exercises, 2 balance, 1 mobility, and 2 stretches. The strengthen exercises were as followed: band press, band row, dumbbell bicep curls, chair squats, and banded pull apart. Balance included one-foot balance on a foam pad, and a tandem walk. With a history of herniated discs in his back from deadlifting wrong, the prone press, chest stretch, and seated hamstring stretch were added. The patient had no pain in the sternum throughout the training. He kept to these exercises for the next 9 sessions. Cardio performed was a treadmill incline walk and the rower. OUTCOME At the 30 day reassessment the average METs increased to 4.3. Advancing the patient to the dumbbells, machines, and increase the resistance and repetitions. At the 60 day reassessment the average METs increased again to 5.2. Again, at the 90 Day reassessment the METs increased again to average 5.7. The patient progressed to an A/B schedule with strength training performing higher intensity exercises for strength and cardiovascular health. The cardiovascular exercises were elliptical, boxing, and the Stairmaster. On the final day of exercise the Bruce ETT was performed. Achieving 10.2 METs, at 8:12 minutes stopping due to fatigue. This was a 325% increase from his very first day of exercise. Further evidence of strength gains reflected from his 5 rep max test (5RM) we completed as well. Testing his muscular strength and endurance. DISCUSSION Being able to lift weights and gain strength back sooner than later can help with recovery after open heart surgery in cardiovascular and strength gains. Pain being the guide for the patient with KYMITT allows more freedom for the patient leading to decreased anxiety as well using their upper extremities.

RELIABILITY OF POPLITEAL ARTERY FLOW-MEDIATED DILATION IN THE SEATED POSITION

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INTRODUCTION: Flow-mediated dilation (FMD) is a noninvasive measure of endothelial function used to assess cardiovascular risks. The popliteal artery is commonly used for FMD measurement in different body positions, which may impact its reliability. This study aimed to examine the reliability of popliteal artery FMD in the seated position, as no previous studies have examined this. METHODS: Popliteal artery FMD was measured in 20 healthy adults across two visits in seated and prone positions to assess visit-to-visit reliability, with two measurements taken for each body position at each visit for trial-retrial reliability. %FMD was calculated as the percent change from baseline diameter to peak diameter. The reliability of FMD was assessed via intraclass correlation coefficient (ICC). RESULTS: Popliteal artery %FMD shows moderate-to-good reliability in the seated position (ICC: 0.67 to 0.89) and poor-to-moderate reliability in the prone position (ICC: 0.25 to 0.74) within and between visits. There were no significant differences in baseline diameter or minimum diameter between body positions, visits, or trials ($p>0.05$). %FMD and peak diameter following cuff deflation demonstrated no significant difference between body positions ($p>0.05$). CONCLUSION: Popliteal artery FMD demonstrates good reliability in the seated position, supporting the development of a standardized measurement protocol.

THE EFFECT OF ACE'S ON PHYSIOLOGICAL MEASURES OF HEALTH

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BACKGROUND: The aim of this study was to determine if Adverse Childhood Experiences (ACE's) are related to physiological measures of health. ACE's are associated with an increase in the inflammatory response. Chronic inflammation is linked to diseases such as heart disease, lung disease, and cancer as well as immunologic conditions. Lifestyle choices such as exercise and dietary habits may potentially counteract those inflammatory changes related to higher ACE's due to the anti-inflammatory properties associated with those choices. METHODS: Participants visited the Exercise Physiology Lab and first completed an informed consent. Following that, participants were given the two survey instruments: ACE's assessment and Simple 7 assessment. Participants were to complete each survey assessment and place the completed assessments in a sealed manilla envelope. After completing the survey instruments, participants had resting blood pressure, height, weight and body composition (Tanita body fat scale) measurements completed. Following the resting measures participants put on a Polar telemetry strap and started a self-selected warm-up on the treadmill. After a 5-min warm-up, participants started a Bruce Protocol treadmill test that was terminated at 80% of age-predicted maximum heart rate or a request to stop or for any reason signifying cardiopulmonary distress . A correlational analysis was conducted using SPSS v30. RESULTS: In total12 participants (8 female, 4 male) were analyzed. Body mass index (BMI) and age of first occurrence for the ACE's assessment were correlated, $p = 0.045$, $r = -0.587$. Other correlations were trending towards significance but due to a smaller sample size, significance was not achieved. ACE's and stage RPE ($p = 0.084$, $r = 0.519$), heart rate at test termination ($p = 0.054$, $r = 0.568$) and resting arterial pulse pressure ($p = 0.097$, $r = -0.502$) were not significantly correlated. ACE's assessment part 2 regarding support systems had a trending correlation with resting mean arterial pressure ($p = 0.097$, $r = -0.501$). CONCLUSIONS: ACE's may have a long-term physiological impact from psychological stress at a younger age. Data showed those with an earlier age of adverse experiences, correlated with a higher BMI. High BMI is associated with many chronic diseases such as heart disease, lung disease, metabolic diseases and cancer. With other data trending toward significance, further investigation into ACE's and health values should be explored to determine the long-term impact of psychological damage from childhood.

NEUROCOGNITIVE MOBILE APPLICATION PERCEPTION OF USABILITY IN ADULTS WITH PARKINSON'S

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INTRODUCTION: Mobile technology and applications are now commonly used for neurocognitive testing. Adequate motor control is necessary to perform such assessments. This study assessed the perceived usability of three neurocognitive mobile applications among healthy individuals and those with Parkinson's Disease (PD). METHODS: 25 adults (10 females, 15 males), aged 57 to 81 years, divided into two groups: (1) without PD (n= 11; m= 70.36 ± sd= 6.87yrs) and (2) with PD (n= 14; m= 72.64 ± sd= 4.55yrs). Participants completed three trials (initial, wk2, wk4) on three neurocognitive mobile applications (NMA) (app1-smartphone, app2-tablet, app3-touchscreen monitor). Following each trial, perceived level of difficulty (PLD) per NMA was recorded, and NMA preference ranked. Two separate 3x3x2 repeated measures ANOVAs were administered. First, PLD of NMA across trials between groups, and the second to determine preference of NMA. RESULTS: Greenhouse-Geisser on PLD reported a significant main effect for NMA, $F(1.501, 16) = 6.354$, $p= 0.01$, $\eta p^2 = 0.28$, power = 0.79. No other interactions or main effects for PLD of NMA across trials between groups were found to be significant ($p< 0.05$). Post-hoc PLD tests revealed both the app1-smartphone ($p= 0.01$) and app2-tablet ($p= 0.02$) were significantly easier to use than app3-touchscreen monitor for non-PD. Greenhouse-Geisser also determined preference rankings of the three NMA across trials between groups showing a significant main effect of the NMA, $F(1.966, 16) = 14.884$, $p < 0.001$, $\eta p^2 = 0.48$, power = 0.99. All other analyses showed no significant interactions or main effects ($p< 0.05$). Post-hoc tests revealed app1-smartphone was the most preferred NMA irrespective of PD status followed by app2-table, and app3-touchscreen being the least preferred. CONCLUSIONS: Findings suggest, smartphones and tablets were generally perceived as easier to use than touchscreen monitors for neurocognitive assessments, regardless of PD status. Furthermore, participants consistently favored the smaller smartphone and app followed by the tablet-driven app, with the larger touchscreen monitor and app being least preferred. These findings highlight the importance of considering motor control challenges, especially for individuals with PD, when selecting devices for neurocognitive testing.

MOTRPAC CPET CORE LAB - QUALITY CONTROL AND THRESHOLD DETERMINATIONS

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INTRODUCTION: The Molecular Transducers of Physical Activity Consortium (MoTrPAC) protocol includes collection of cardiopulmonary exercise testing (CPET) data as a key clinical outcome. Due to the large volume of data and institutions involved in MoTrPAC, a CPET Core Lab was created to manage a CPET data repository, evaluate data quality, and analyze metabolic events in the continuous data like ventilatory thresholds (VT). METHODS: All clinical centers involved in MoTrPAC conducted CPETs on cycle ergometers following individualized ramp protocols. The CPET Core Lab determines the VTs in all past and current CPETS: VT1 (ventilatory threshold 1) and VT2 (ventilatory threshold 2 or Respiratory Compensation Point) as data permits. VT1 is the point where VE and VCO2 increase at a greater rate than VO2. VT2 occurs when VE increases curvilinearly compensating for excess CO2 production. Two independent adjudicators will review each test and independently determine VT1 and VT2. To ensure quality control between adjudicators, repeated VT readings were performed 2 times on 20 blinded tests by 3 adjudicators. This quality control (QC) evaluation process was performed to establish between- and within-adjudicator concordance and agreement by concordance coefficient correlation (ρc) and Bland and Altman analysis, respectively. Adjudicators analyzed all CPETs without doing any additional confirmatory QC. RESULTS: The metrics calculated on these data showed a high within-adjudicator concordance (ρc range 0.965 to 0.744) and agreement without significant proportional or systematic bias. Within-adjudicator coefficient of variation was below 8% (range 4.12% to 7.88%) for all adjudicators for both VT1 and VT2. The overall coefficient of variation for all adjudicators was 9.9% for VT1 and 10.7% for VT2 between adjudicators, and below 150 ml/min as empirically suggested. CONCLUSIONS: VT1 and VT2 reading between-adjudicator had a good concordance and agreement. Additional QC procedures between adjudicators are planned to achieve higher levels of reliability and agreement.

ELECTROMYOGRAPHIC ANALYSIS OF MULTIFIDUS MUSCLE ACTIVITY DURING THREE EXERCISES

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INTRODUCTION: The multifidus muscle is integral to spinal stability and posture control. To enhance rehabilitation and training programs, it is essential to understand the patterns of its activation across various exercises. The purpose of this study was to analyze the electromyographic (EMG) activity of the multifidus muscle during three specific exercises: deadlifts, bird-dogs, and single-leg balance exercises, to determine which exercise most effectively activates this muscle. METHODS: Twenty adults (men: 9; women: 11; age: 24.7+2.1 yr; height: 167.9+10.8 cm; weight: 73.9+15.8 kg (mean+SD)) participated in the study. Surface EMG electrodes were placed bilaterally at the L4-L5 level after skin preparation. Deadlifts (5 reps at 50% body weight), bird-dog held for 10 sec on each side while holding a 2.27 kg weight in the outstretched hand, and single-leg stance held for 10 sec on each foot were performed under supervision in a randomized order. EMG data (max amplitude) were recorded with each session lasting ~15 minutes. Data were analyzed to compare muscle activation patterns across exercises. RESULTS: EMG activity showed significant ($p<0.05$) differences across exercises with deadlifts inducing the highest mean muscle activation (0.949+0.623 mV), followed by bird-dog right (0.370+0.173 mV) and bird-dog left (0.352+0.161 mV). The single-leg balance exercises elicited the lowest mean muscle activations, both for the right (0.124+0.049 mV) and left sides (0.134+0.068 mV). There were no bilateral differences for any of the exercises. CONCLUSIONS: The multifidus muscle showed varying levels of activation across different exercises, with the highest activation during deadlifts and the lowest during single-leg balance tasks. The deadlifts elicited a significantly stronger muscle response compared to balance exercises, suggesting that weight-bearing exercises might be more effective for multifidus muscle activation. The findings suggest that rehabilitation programs that include deadlifts could potentially offer greater benefits for improving core stability and reducing back pain.

IMPACT OF SLEEP REACTIVITY ON HEALTH OUTCOMES IN ADULTS WITH INSOMNIA SYMPTOMS

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BACKGROUND: High levels of sleep reactivity (SR) —the sensitivity of sleep patterns to stress— have been associated with a risk of developing insomnia disorder. Furthermore, insomnia disorder increases vulnerability to negative health outcomes such as decreased stamina and overall fatigue. Recognizing how SR contributes to these adverse health effects allows for the development of more effective training programs and rehabilitation services. The purpose of this study was to examine the association between SR with sleep, cardiovascular, and mental health (MH) in adults with insomnia symptoms. METHODS: Data were collected on 33 insufficiently active adults (age=34.9±10.6 y, body mass index [BMI]=28.7±7.2 kg·m−2, female=84.8%, White=78.8%) with self-reported insomnia symptoms (Insomnia Severity Index=15.9±3.9). SR was assessed using the Ford Insomnia Reactivity to Stress Test (FIRST) questionnaire. The total score ranges from to 9-36; with higher scores associated with greater sleep difficulties when experiencing stress. Sleep was tracked using 7 nights of actigraphy and a sleep diary, variables included sleep efficiency (SE), total sleep time (TST), and wake after sleep onset (WASO). Cardiovascular outcomes included daytime resting heart rate variability (HRV), systolic and diastolic blood pressure, body fat %, and 1 night of nocturnal HRV. MH assessments measured anxiety (General Anxiety Disorder-7 [GAD-7] questionnaire) and depression (Patient Health Questionnaire [PHQ-9]) symptoms. Linear regression models were adjusted for race, age, sex, and BMI. RESULTS: Participants had a mean FIRST score of 24.2±5.8, indicating that 90.9% of participants had a high risk of developing insomnia disorder (FIRST ≥18). SR was not significantly associated with actigraphy- or diary-assessed SE, TST, or WASO (each $p>0.174$). SR was not significantly associated with daytime cardiovascular outcomes or nocturnal HRV (each $p>0.116$). Higher SR was significantly associated with greater anxiety ($\beta=0.40$, $p=0.045$) and depression ($\beta=0.39$, $p=0.05$) symptoms. CONCLUSION: These cross-sectional data suggest that SR is associated with psychological symptoms, but not sleep or cardiovascular outcomes. Although SR demonstrated an impact on MH outcomes, future research should investigate its potential indirect relationship with physical health. Additionally, given the impact of physical activity on both mental and physical health, it is essential to explore early physical activity interventions to improve MH outcomes and reduce the risk of insomnia disorder.

CLINICAL EXERCISE PHYSIOLOGISTS IN THE INPATIENT SETTING – A CASE STUDY

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INTRODUCTION: Preservation of functional capacity for patients admitted to the cardiovascular intensive care unit (CVICU) relies heavily on interventions prescribed by physical therapy. Traditional interventions are bed/chair exercises utilizing only body weight and ambulation around the unit. In this case, the clinical exercise physiologist (CEP) sought to push this standard of care to prepare a subject implanted with a BiVACOR total artificial heart (TAH) for orthotopic heart transplantation (OHT). This serves to present the methods in doing so and the need to further implement the role of clinical exercise physiologists in the inpatient setting. CASE PRESENTATION: A 51-year-old male with history of chronic nonischemic cardiomyopathy, hypertension, diabetes mellitus, hyperlipidemia, and obesity presented to the hospital for right heart catheterization (RHC) in the setting of increased heart failure symptoms. Results of RHC led to admission and listing as UNOS status 4 for OHT. Hospital course was complicated by hypotension, ventricular tachycardia, and chronic kidney disease. Cardiothoracic surgery determined the need for mechanical circulatory support, a TAH as bridge to transplant. The patient elected to undergo implantation of BiVACOR, a TAH geared towards individuals with biventricular or univentricular heart failure where left ventricular assist device is not recommended. The patient is part of the BiVACOR Early Feasibility Trial in humans, approved by the FDA – he was the third human implant and would remain in hospital until OHT. The goal of the multi-disciplinary team was to preserve functional capacity during admission. MANAGEMENT: Before implant, the patient's 6-minute walk test (6MWT) distance was 320 meters, 2.52 METs. Post-implant in the ICU, the patient walked 1,800 feet 4 times per day. His 6MWT distance 13 days post-implant was 411 meters, 2.95 METs. By day 22 post-implant the patient progressed to recumbent bike cycling intervals. He was able to tolerate one 3-minutes interval and two 4-minutes intervals, split by 6-minutes rest intervals. His prescription was to cycle at 55-65 RPMs for 10-15 minutes three days per week with progression to 30 minutes continuously, 5-6 days per week. The patient was transplanted prior to completing any further sessions. During the cycling session, his blood lactate was measured at 5.2 mmol and hemoglobin 5.7 g/dL. His blood pressures remained stable, with normal responses to exercise, and pump flow increased from 8.9 L/min at rest to 12.5 L/min at peak exercise. Reported quadriceps muscle fatigue was the reason for session discontinuation. DISCUSSION: Inpatient rehab goals of care should evolve to include various modalities of exercise that allow for more physiological adaptations, decreasing the impact of frailty and improving quality of life during

admission. This patient's case is an attestation to the growing need for exercise intervention prescribed by the CEP at all levels of care.

TELEHEALTH PROGRAM CREATES EXERCISE HABIT FOR NON-ADHERENT PATIENT WITH ORTHOSTATIC INTOLERANCE

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INTRODUCTION: Orthostatic Intolerance (OI) impacts patients' ability to perform activities of daily living (ADLs) often leading to symptom exacerbation and significant deconditioning over time. Exercise aids symptom control by increasing cardiac output and venous return. Creating and maintaining an exercise routine often requires additional supports. CASE PRESENTATION: A 15-year-old female was referred for a 6-month history of postural dizziness and presyncope. At the initial clinic visit, orthostatic testing was completed which showed a 27-bpm increase in heart rate. Baseline ECG showed sinus rhythm with normal intervals and review of systems was unremarkable. Patient history, symptoms and testing were noted to be consistent with OI. Initial interventions included general exercise resources and education materials, such as a daily aerobic walking plan (begin with 5-minute duration and increase by 5 minutes/week until 60 minutes total is achieved per day). Quarterly to bi-yearly clinic follow-ups showed no improvement in symptoms, despite reinforcing exercise recommendations and education at each visit. Follow up repeat testing, predicted aerobic capacity assessment, muscular endurance assessment, and surveys were completed. Exercise physiologist (ExP) initiated telehealth exercise sessions. OUTCOME: Prior to intervention, patient physical activity consisted of walking at work. ExP conducted eleven telehealth exercise sessions over a 3-month period (30 min duration, 2 times/week). Sessions included education on form, safety, exercise components, & intensity progression. Resistance exercises were completed with real-time supervision and feedback. Following completion of the telehealth program, testing showed decrease in symptom severity (-110%), increase in predicted aerobic capacity (+28%), maintenance of lower extremity muscular endurance (-6%), decrease in fatigue (-62%), and maintenance of mobility (-27%). One month post completion of telehealth intervention patient remained adherent to exercise prescription of aerobic exercise (2 times/week) & strength training (2 times/week). DISCUSSION: Early clinic education emphasized the importance of exercise for this patient; however, neither education nor clinic resources resulted in adherence to an exercise routine. Virtually delivering high quantity, synchronized exercise sessions, allowed the patient to experience improvement in functional capacity and reduction in symptom intensity. Virtual delivery of exercise medicine sessions can be applied to multiple clinical conditions and wider delivery to varied patient populations should be explored.

EFFECTS OF NORMOBARIC HYPOXIA AND HIGH-INTENSITY INTERVAL TRAINING ON HEMODYNAMICS

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INTRODUCTION: The purpose of this study was to evaluate the effects of high-intensity interval training (HIIT) at normobaric hypoxia (NH) on measures of hemodynamics. METHODS: Ten active adults aged 23±1 years volunteered to complete a HIIT intervention at a randomized condition (sea level (SL); low NH (900m); moderate NH (2500m), high NH (4300m)) separated by 72 hours. After acclimating to the condition for 45 minutes (Rest), participants completed a HIIT intervention consisting of six bouts of high-intensity cycling separated by three minutes and 30 seconds of active recovery (AR). Hemodynamic variables included systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), pulse pressure (PP), and rate pressure product (RPP). They were assessed at Rest, during the final AR (AR6), and five minutes following the final bout of exercise (Post). A two-way repeated analysis of variance (ANOVA) was used to analyze the effects of condition (SL, 900m, 2500m, 4300m) across the repeated factor of time (Rest, AR6, Post) in response to HIIT. RESULTS: There was a significant ($p \leq 0.05$) main effect of time for HR, SBP, DBP, MAP, PP, and RPP. At all conditions, HR (SL: Rest: 62±9bpm; AR6: 156±21bpm; Post: 104±15bpm; 900m: Rest: 61±10bpm; AR6: 161±10bpm; Post: 109±19bpm; 2500m: Rest: 64±11bpm; AR6: 167±14bpm; Post: 104±14bpm; 4300m: Rest: 67±14bpm; AR6: 171±11bpm; Post: 111±19bpm) increased following Rest, and AR6 was greater than Post. Additionally, at all conditions, SBP (SL: Rest: 116±7mmHg; AR6: 154±16mmHg; Post: 134±13mmHg; 900m: Rest: 119±8mmHg; AR6: 152±10mmHg; Post: 133±13mmHg; 2500m: Rest: 120±10mmHg; AR6: 153±12mmHg; Post: 136±14mmHg; 4300m: Rest: 116±10mmHg; 4300m AR6: 149±15mmHg; Post: 136±14mmHg) increased following Rest. More so, MAP at Rest was lower than AR6 and Post at SL (Rest: 66±5mmHg; AR6: 69±7mmHg; Post: 60±2mmHg) and 900m (Rest: 68±5mmHg; AR6: 70±8mmHg; Post: 68±7mmHg). At AR6, MAP was higher than Post at 900m. Similarly, PP (SL: Rest: 50±7mmHg; AR6: 85±15mmHg; Post: 64±15mmHg; 900m: Rest: 51±7mmHg; AR6: 82±10mmHg; Post: 63±11mmHg; 2500m: Rest: 48±6mmHg; AR6: 85±14mmHg; Post: 66±10mmHg; 4300m: Rest: 44±6mmHg; AR6: 77±14mmHg; Post: 63±11mmHg) was augmented following Rest at all conditions, and AR6 was higher than Post at SL, at 900m. Finally, RPP (SL: Rest: 71±13mmHg; AR6: 216±42mmHg; Post: 139±21mmHg; 900m: Rest: 73±15mmHg; AR6: 204±34mmHg; Post: 145±28mmHg; 2500m: Rest: 78±17mmHg; AR6: 202±30mmHg; Post: 141±22mmHg; 4300m: Rest: 79±21mmHg; AR6: 208±30mmHg; Post: 152±31mmHg) increased following Rest, and Post was lower than AR6, at all conditions. No other significant main effects, conditions, or interactions were observed. CONCLUSIONS: While both NH and HIIT increase measures of hemodynamics, combining HIIT and NH does not further augment such variables. Thus, engaging in HIIT at NH does not increase cardiovascular stress or the risk of experiencing a cardiovascular event compared to HIIT at SL.

INTER-INDIVIDUAL RESPONSE DIFFERENCES ON CARDIORESPIRATORY FITNESS IN HEART FAILURE

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BACKGROUND: Previous studies have shown an association between low cardiorespiratory fitness (CRF) and mortality in adults with heart failure with preserved ejection fraction (HFpEF). While exercise-based cardiac rehabilitation (EBCR) has been reported to increase CRF in adults with HFpEF, true inter-individual response differences (IIRD) to EBCR among those with HFpEF is not known nor has it ever been assessed. The purpose of this study was to address this gap. METHODS: Using data from the recent American Heart Association and American College of Cardiology statement on supervised exercise training for chronic HFpEF, eight randomized controlled trials representing 503 adults (260 exercise, 243 control) were included and pooled for a standard deviation of individual response (SDIR) meta-analysis on changes in CRF, assessed as VO2peak in mL.kg-1min-1. The inverse heterogeneity (IVhet) model was used to pool results. RESULTS: The pooled 95% confidence interval (CI) for the SDIR included zero (mean, 0.5, 95% CI, -1.9 to 2.0 mL.kg-1min-1). With each study deleted from the model once, results continued to not reach statistical significance. The 95% prediction interval for the SDIR, indicative of what result one might expect is they conducted their own randomized controlled trial, was -3.3 to 3.3 mL.kg-1min-1. The probability of a clinically meaningful difference of at least 1.0 mL.kg-1.min-1 in VO2peak was 50.6% (only possibly clinically important). CONCLUSION: There is a lack of exercise-associated IIRD on VO2peak in adults with HFpEF once random and within-subject variation are properly accounted for. Thus, a search for potential moderators and mediators, including genetic interactions, on VO2peak in adults with HFpEF cannot be supported at this time.