Research Studies Involving NuStep Recumbent Cross Trainers

The following abstracts and links are provided for those interested in reading about medical, physiological, and other research that has tested the use and efficacy of NuStep Recumbent Cross Trainers for a variety of populations and conditions.

We will continue to add new references as they become available.

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Concurrent improvements in cardiorespiratory and muscle fitness in response to total body recumbent stepping in humans

Hass CJ, Garzarella L, de Hoyos DV, Connaughton DP, Pollock ML.

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Neural Coupling Between Upper and Lower Limbs During Recumbent Stepping

Huang, Helen J. and Ferris, Daniel P.

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During gait rehabilitation, therapists or robotic devices often supply physical assistance to a patient's lower limbs to aid stepping. The expensive equipment and intensive manual labor required for these therapies limit their availability to patients. One alternative solution is to design devices where patients could use their upper limbs to provide physical assistance to their lower limbs (i.e., self-assistance). To explore potential neural effects of coupling upper and lower limbs, we investigated neuromuscular recruitment during self-driven and externally driven lower limb motion. Healthy subjects exercised on a recumbent stepper using different combinations of upper and lower limb exertions. The recumbent stepper mechanically coupled the upper and lower limbs, allowing users to drive the stepping motion with upper and/or lower limbs. We instructed subjects to step with 1) active upper and lower limbs at an easy resistance level (active arms and legs); 2) active upper limbs and relaxed lower limbs at easy, medium, and hard resistance levels (self-driven); and 3) relaxed upper and lower limbs while another person drove the stepping motion (externally driven). We recorded surface electromyography (EMG) from six lower limb muscles. Self-driven EMG amplitudes were always higher than externally driven EMG amplitudes (P < 0.05). As resistance and upper limb exertion increased, self-driven EMG amplitudes also increased. EMG bursts during self-driven and active arms and legs stepping occurred at similar times. These results indicate that active upper limb movement increases neuromuscular activation of the lower limbs during cyclic stepping motions. Neurologically impaired humans that actively engage their upper limbs during gait rehabilitation may increase neuromuscular activation and enhance activity-dependent plasticity.

Moving the Arms to Activate the Legs

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Upper and Lower Limb Muscle Activation Is Bidirectionally and Ipsilaterally Coupled

Huang, Helen J. and Ferris, Daniel P.

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PURPOSE: There are neural connections between the upper and lower limbs of humans that enable muscle activation in one limb pair (upper or lower) to modulate muscle activation in the other limb pair (lower or upper, respectively). The aims of this study were to extend previous findings regarding submaximal exercise to maximal effort exercise and determine whether there is an ipsilateral or contralateral bias to the neural coupling during a rhythmic locomotor-like task.

METHODS: We measured upper and lower limb muscle activity, joint kinematics, and limb forces in neurologically intact subjects (n = 16) as they performed recumbent stepping using different combinations of upper and lower limb efforts.

RESULTS: We found increased muscle activation in passive lower limbs during active upper limb effort compared with passive upper limb effort. Likewise, increased muscle activation in passive upper limbs occurred during active lower limb effort compared with passive lower limb effort, suggesting a bidirectional effect. Maximal muscle activation in the active lower limbs was not different between conditions with active upper limb effort and conditions with passive upper limb movement. Similarly, maximal muscle activation in the active upper limbs was not different between conditions with active lower limb effort and conditions with passive lower limb movement. Further comparisons revealed that neural coupling was primarily from active upper limb muscles to passive ipsilateral lower limb muscles.

CONCLUSION: These findings indicate that interlimb neural coupling affects muscle recruitment during maximal effort upper and lower limb rhythmic exercise and provides insight into the architecture of the neural coupling.


Abstract courtesy of Lippincott Williams & Wilkins.
Resistance-based, Reciprocal Upper and Lower Limb Locomotor Training in Chronic Stroke: a Randomized, Controlled Crossover Study

S. Page, P. Levine, J. Teepen, E. Hartman

Departments of Rehabilitation Sciences and Physical Medicine and Rehabilitation, and the Institute for Health Policy and Health Services Research, University of Cincinnati Academic Medical Center, Neuromotor Recovery and Rehabilitation Laboratory, Drake Rehabilitation Center, Cincinnati, OH

OBJECTIVE: To determine efficacy of a bilateral reciprocal training regimen on affected leg impairment and dynamic balance.

DESIGN: Randomized, controlled, single-blinded crossover study. Setting: Outpatient rehabilitation hospital.

PARTICIPANTS: Seven patients who experienced stroke >1 year prior to study entry exhibiting affected leg weakness.

INTERVENTION: Subjects were randomly assigned to receive both of the following in a randomized, sequential order: (a) a resistance-based, reciprocal, affected leg locomotor training protocol using the NuStep apparatus (n = 4) and (b) a home exercise programme (HEP) consisting of self-supervised practice with fractionated joint movements of the lower limb. Each phase of the intervention was performed for 30 minutes each session, three days a week, and conducted over an eight-week period.

MAIN OUTCOME MEASURES: Outcomes were evaluated by a blinded rater using the lower extremity scale of the Fugl-Meyer and the Berg Balance Scale.

RESULTS: After HEP participation, subjects showed nominal or no changes on any of the outcome measures. After NuStep participation, patients in both treatment groups showed impairment reductions as shown by the Fugl-Meyer (+4.3; +2.2), and increased balance as shown by the Berg Balance Scale (+4.0; +4.0). These trends were exhibited regardless of group assignment.

CONCLUSION: Impairment reductions and balance gains may be achieved using a resistance-based, reciprocal upper and lower limb locomotor training protocol.

Effects of Recumbent Stepper Exercise on Blood Pressure, Strength and Mobility in Residents of Assisted Living Communities: A Pilot Study

Johnson, T., McPhee, S., & Deitrich, M.

Belmont University, Nashville, TN.

OBJECTIVE: To examine the effects of a total body recumbent stepper exercise program on blood pressure, strength and walking speed in elderly, assisted-living residents.

DESIGN: A non-experimental (longitudinal) pre-post-test descriptive design was used to determine changes in physical performance measures after 13 weeks of recumbent stepper exercising.

SETTING: Morningside Assisted-Living Communities in Middle Tennessee.

PARTICIPANTS: Thirty-nine volunteer, assisted-living residents with mean age of 85.5 ± 6.6 years, height of 1.6 ± .1 m, and weight of 63.6 ± 9.6 kg.

INTERVENTIONS: Recumbent Stepper exercise program. The residents were classified into two groups based on the total time of exercise logged over the test period. One group exercised less than an average of nine minutes per week while the other group averaged nine or more minutes of exercise per week.

MAIN OUTCOMES MEASURES: The residents were tested on physical characteristics, sitting and standing blood pressure, mobility (15.2 meter timed walk), and six strength measurements on a hydraulic exercise machine.

RESULTS: Statistically significant differences pre- and post-intervention were found on several measures of blood pressure, strength, and mobility. While residents exercising less than nine minutes per week tended to remain stable or show changes in adverse directions on these measures (e.g., decreased Shoulder Press strength, p < .05), residents exercising at least nine minutes per week demonstrated positive improvements (e.g., Knee Flexion and Back Pulldown, p < .01), as well as increased mobility (p < .01). Statistically significant decreases were also found for measures of sitting and standing blood pressure (p < .05).

CONCLUSIONS: The results of this study revealed that assisted-living residents who exercised on a recumbent stepper as little as nine minutes per week decreased blood pressure, and increased strength and walking speed. This effect holds true even in the oldest-old individuals.

Modified total-body recumbent stepper exercise test for assessing peak oxygen consumption in people with chronic stroke.


Billinger SA, Tseng BY, Kluding PM.

Metabolic, Strength, and Energy Lab, Department of Physical Therapy and Rehabilitation Science, University of Kansas Medical Center, 3901 Rainbow Blvd, Kansas City, KS 66160, USA.

BACKGROUND: Assessment of peak oxygen consumption (Vo(2)peak) using traditional modes of testing such as treadmill or cycle ergometer can be difficult in individuals with stroke due to balance deficits, gait impairments, or decreased coordination. OBJECTIVE: The purpose of this study was to quantitatively assess the validity and feasibility of a modified exercise test using a total-body recumbent stepper (mTBRS-XT) in individuals after stroke. DESIGN: A within-subject design, with a sample of convenience, was used. PARTICIPANTS: Eleven participants (7 male, 4 female) with a mean of 40.1 months (SD=32.7) after stroke, a mean age of 60.9 years (SD=12.0), and mild to severe lower-extremity Fugl-Myer test scores (range=13-34) completed the study. METHODS: Participants performed 2 maximal-effort graded exercise tests on separate days using the mTBRS-XT and a cycle ergometer exercise protocol to assess cardiorespiratory fitness. Measurements of Vo(2)peak and peak heart rate (peak HR) were obtained during both tests. RESULTS: A strong relationship existed between the mTBRS-XT and the cycle ergometer exercise test for Vo(2)peak and peak HR (r=.91 and .89, respectively). Mean Vo(2)peak was significantly higher for the mTBRS-XT (16.6 mL x kg(-1) x min(-1)[SD=4.5]) compared with the cycle ergometer exercise protocol (15.4 mL x kg(-1) x min(-1) [SD=4.5]). All participants performed the mTBRS-XT. One individual with severe stroke was unable to pedal the cycle ergometer. No significant adverse events occurred. CONCLUSION: The mTBRS-XT may be a safe, feasible, and valid exercise test to obtain measurements of Vo(2)peak in people with stroke. Health care professionals may use the mTBRS-XT to prescribe aerobic exercise based on Vo(2)peak values for individuals with mild to severe deficits after stroke.

Supplemental video - an individual with chronic stroke attempting to mount and pedal a cycle ergometer. The same individual is then transferred to the total-body recumbent stepper. (Video requires Quick Time video player or browser plug-in.)

PMID: 18772275 [PubMed - indexed for MEDLINE]

Validity of a total body recumbent stepper exercise test to assess cardiorespiratory fitness.


Billinger SA, Loudon JK, Gajewski BJ.

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Maximum oxygen consumption ($\dot{V}O_{2\max}$) is the primary measure for cardiorespiratory fitness, and the $\dot{V}O_{2\max}$ value achieved on the treadmill using the Bruce protocol is considered the gold standard. A novel exercise test using a total body recumbent stepper (TBR$S$) would be an alternative for measuring $\dot{V}O_{2\max}$ in healthy individuals. Furthermore, the TBR$S$ exercise test (TBR$S$-XT) may be beneficial for individuals such as those with stroke, who cannot tolerate a treadmill or cycle ergometer test due to hemiparesis, increased tone in the extremities, or balance deficits. The purpose of the study was to assess the validity and reliability of the TBR$S$-XT in determining $\dot{V}O_{2\max}$ in healthy adults. Twenty-two healthy adults (9 women, 13 men; 26.9 +/- 6.1 years of age) participated in 2 maximum exercise tests in random order. One exercise test was performed on the treadmill using the Bruce protocol and the other exercise test was the TBR$S$-XT. Statistical analysis of the data was conducted using simple linear regression where the response variable was the $\dot{V}O_{2\max}$ from the Bruce protocol and the predictor variable was the $\dot{V}O_{2\max}$ from the TBR$S$-XT. A 95% prediction interval was used to assess the strength of the prediction of $\dot{V}O_{2\max}$ from the Bruce protocol with $R^2 = 0.851$. Preliminary data suggest that the TBR$S$-XT may be a valid test to predict $\dot{V}O_{2\max}$ when treadmill testing is not feasible. This would allow clinicians an alternative method for exercise testing and prescription to promote healthy lifestyle interventions for a variety of patient populations.

PMID: 18714232 [PubMed - indexed for MEDLINE]

Evaluation of Cardiorespiratory Fitness in Morbidly Obese Adults: A Feasibility Study

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BACKGROUND: The emergence of bariatric surgery as a viable option for the treatment of extreme obesity has created the need to evaluate the cardiovascular status of this escalating patient population as part of a pre-surgical screening protocol. Maximal exercise testing in this cohort is often limited by confounding variables such as early onset of fatigue, physical discomfort, poor motivation, equipment limitations, or combinations thereof. These factors, singly and collectively, often preclude the completion of a valid and reliable test.

PURPOSE: To minimize the body habitus limitations presented by conventional motorized treadmills or cycle ergometers, we used the NuStep TRS 4000 recumbent cross trainer (NuStep, Inc. Ann Arbor, MI) to evaluate the cardiorespiratory fitness of this unique population.

METHODS: Maximal exercise testing was performed in conjunction with the direct measurement of somatic oxygen consumption on 12 (5 men, 7 women; mean ± SD age = 51 years) morbidly obese individuals (mean ± SD BMI 62 ± 13 kg/m2) using the NuStep recumbent cross trainer. These patients were referred to our laboratory as a component of their pre-bariatric surgical screening. Primary indications for the use of this protocol were a body weight greater than 400 lbs. (182 kg), physical limitations preventing the use of a treadmill or cycle ergometer, or both. Exercise testing was initiated at a workload approximating 450 kpm/min and increased ∼120 kpm/min every two minutes to volitional fatigue, or when the designated pedaling rate (100 steps per minute) could no longer be maintained. RESULTS: Patients achieved a VO2 peak of 12.5 ± 3.4 ml/kg/min at an average respiratory exchange ratio of 1.0 ± 0.10. Rating of perceived exertion at peak exercise averaged 17 (very hard) on the Borg (6-20) category scale. Anaerobic threshold was determined in 8 of the 12 subjects, with a mean value occurring at 7.4 ± 2.4 ml/kg/min, equal to 63 ± 16% VO2 peak. Peak heart rate averaged 135 ± 19 bpm, corresponding to 80% of age predicted maximal values. Only two of the 12 patients were on beta-blocker therapy. Moreover, all tests were completed safely, with no cardiovascular or musculoskeletal complications, and without ischemic ST segment changes, anginal chest pain, or malignant ventricular arrhythmias.

CONCLUSION: Peak or symptom-limited exercise testing of morbidly obese patients can be completed safely and effectively utilizing the NuStep recumbent cross trainer. The information obtained can reliably be used to assess the patient’s electrocardiographic response, hemodynamics, and cardiorespiratory fitness prior to bariatric surgery. Abstract of research findings presented at the Annual Meeting of the American College of Sports Medicine, May, 2004. Abstract courtesy of Medicine & Science in Sports & Exercise, official journal of the American College of Sports Medicine.
Cardio-Respiratory Responses to Maximal Exercise of Persons with M.S. Using Different Modes of Exercise

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Division of Physical Therapy. University of Utah, Salt Lake City, UT

The purpose of this study was to compare the cardio-respiratory responses of persons with Multiple Sclerosis (MS) during maximal exercise testing using four different modes of exercise. Six women with a definite diagnosis of MS (mean [range]; age = 47 yrs [38-60], EDSS = 4.6 [2-6]) and neurogenic lower extremity weakness evident by visible gait deviations underwent four maximal exercise tests utilizing a standard Adapted Bruce Treadmill Protocol (TM), a ramped cycle ergometer protocol (BI), and two modes of combined arm/leg ergometry, a total body cycle ergometer (SA) and a recumbent total body stepper (NU) to measure peak oxygen uptake and peak heart rate. Maximal exercise values were analyzed with a Repeated Measures ANOVA and Neuman-Keuls post hoc procedure with p-values adjusted for multiple comparisons (a=0.05).

### Comparison of VO2peak (l/min) and HRpeak (bpm) means (± SD)

<table>
<thead>
<tr>
<th></th>
<th>TM: 1.4 ± 0.2</th>
<th>BI: 1.5 ± 0.2</th>
<th>NU: 1.7 ± 0.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>BI</td>
<td>1.5 ± 0.2</td>
<td>NS (0.13)</td>
<td></td>
</tr>
<tr>
<td>NU</td>
<td>1.7 ± 0.2</td>
<td>0.003</td>
<td>0.03</td>
</tr>
<tr>
<td>SA: 1.8 ± 0.2</td>
<td>0.0004</td>
<td>0.002</td>
<td>NS (0.09)</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>TM: 141 ± 19</th>
<th>BI: 155 ± 24</th>
<th>NU: 163 ± 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>BI: 155 ± 24</td>
<td>NS (0.39)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NU: 163 ± 20</td>
<td>0.01</td>
<td>NS (0.29)</td>
<td></td>
</tr>
<tr>
<td>SA: 175 ± 11</td>
<td>0.0006</td>
<td>0.02</td>
<td>NS (0.07)</td>
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</table>

The greater maximal oxygen uptake and heart rate values obtained with SA and NU exercise suggest that combined arm/leg ergometry may be a more effective exercise testing and training method for persons with lower extremity weakness due to neuromuscular disease than treadmill walking or cycling.

Physiological, Metabolic, and Perceptual Responses to Submaximal Exercise Using a Total Body Recumbent Stepper

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The University of Toledo, Toledo, Ohio, USA.

The purposes of this study were:

- to evaluate the physiologic, metabolic, and perceptual responses to submaximal exercise using a total body recumbent stepper
- to assess work load reliability
- to compare predicted vs. measured total calories
- to determine and validate the regression equations for volume of oxygen consumed, heart rate, and total calories

Fifty adults, 18 to 36 years old, were randomly assigned to the experimental and validation groups. Demographics and anthropometric data were recorded. Subjects exercised arms and legs simultaneously at 100 steps per minute. Following the familiarization trials, experimental subjects were randomly assigned to one of two experimental trials. Subjects performed each level until they achieved steady state. Heart rate, differentiated ratings of perceived exertions, and systolic blood pressure were also recorded.

Fifteen experimental subjects performed retest trials. Validation subjects performed a single, steady-state trial at a randomly assigned work load, exercising for four minutes at steady state. Pearson product-moment and interclass correlation coefficients as well as simple regression equations were calculated. Validation procedures consisted of applying the regression equations derived from the experimental data to the independent validation group.

The authors concluded that:

- submaximal exercise using the present ergometer elicited expected physiologic, respiratory-metabolic, and perceptual responses
- the total body recumbent stepper was reliable ($r=.93$ to $.99$, $p<.002$)
- predicted vs. measured total calories were highly correlated ($r=.98$, $p<.0001$)
- volume of oxygen consumed (ml/kg/min) and (l/min), heart rate, and total calories can be reasonably predicted for the selected work loads ($r=.95, .92, .90, .97; p<.005$, respectively).

Physiological and Perceptual Responses to Maximal Exercise Using Different Modes of Exercise

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The purpose of this study was to determine peak cardiorespiratory and perceptual responses of adults to exercise using a total body recumbent stepper (TBRS), a total body cycle ergometer (TBCE), and a standard cycle ergometer (SCE). Ten healthy adults, male and female subjects (21.3 ± 2.3 yr), were recruited. Each subject completed one randomized graded maximal exercise test on each mode. During exercise trials, subjects performed a three-minute warm-up at stage one. Three progressively more demanding submaximal workloads were then performed. Subsequent workloads were advanced each minute by increasing cadence until volitional fatigue. Oxygen consumption was recorded every 30 seconds using open circuit spirometry. Heart rate was obtained for each minute. Ratings of perceived exertion (RPE) (central and peripheral) according to the Borg (6-20) scale were recorded at the end of each stage. Peak values (mean ± SD) were as follows:

<table>
<thead>
<tr>
<th></th>
<th>TBRS</th>
<th>TBCE</th>
<th>SCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>VO2 (ml/kg/min)</td>
<td>37.24±8.73</td>
<td>39.32±9.22</td>
<td>37.05±6.90</td>
</tr>
<tr>
<td>HR (bpm)</td>
<td>178.5±9.20</td>
<td>181.9±8.33</td>
<td>179.5±9.88</td>
</tr>
<tr>
<td>RQ</td>
<td>1.26±0.08</td>
<td>1.29±0.11</td>
<td>1.36±0.10</td>
</tr>
</tbody>
</table>

Data were analyzed using One Way repeated measures ANOVA. No significant differences (p<0.05) were found for peak oxygen consumption, HR, and RQ values among the three ergometers. The three modes of exercise were equally effective in assessing peak oxygen consumption.

Fat Oxidation at Varied Work Intensities Using Different Exercise Modes

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Fat oxidation during four 300 kcal exercise bouts was compared. Ten college students (6F, 4M; 21.2 ± 0.95 yr; 161.6 ± 13.2 cm; 57.8 ± 15.5 kg) were randomly assigned to four exercise trials. Subjects exercised at low and high intensities on a standard bicycle ergometer (SB) and a total body recumbent stepper (RS). Trials were performed after an overnight fast, with ≥ 48 hours rest. Respiratory gases were analyzed every 30 seconds; heart rate and RPR (Borg, 6-20) were recorded. Venous blood samples, pre- and post-exercise, were analyzed for lactate, glycerol, and glucose concentrations. Variables listed below were determined at ten 30-kcal intervals. Results were analyzed with repeated measures ANOVA to compare the effects of intensity and mode.

<table>
<thead>
<tr>
<th>Mode</th>
<th>%VO2peak</th>
<th>RPE</th>
<th>RQ</th>
<th>%Fat</th>
<th>Kcal/min</th>
<th>KcalFat/min</th>
<th>Time(min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS</td>
<td>44.8(1.2)</td>
<td>11.4(0.62)</td>
<td>.87(0.01)</td>
<td>42.8(5.0)</td>
<td>6.08(0.22)</td>
<td>2.52(0.41)</td>
<td>50.8</td>
</tr>
<tr>
<td>RS</td>
<td>70.2(1.3)</td>
<td>13.8(0.65)</td>
<td>.94(0.02)</td>
<td>21.6(4.3)</td>
<td>9.61(0.38)</td>
<td>2.03(0.40)</td>
<td>32.2</td>
</tr>
<tr>
<td>SB</td>
<td>48.6(1.4)</td>
<td>11.1(0.40)</td>
<td>.89(0.01)</td>
<td>35.0(5.3)</td>
<td>6.63(0.34)</td>
<td>2.25(0.32)</td>
<td>48.9</td>
</tr>
<tr>
<td>SB</td>
<td>74.5(1.4)</td>
<td>14.2(0.44)</td>
<td>.96(0.01)</td>
<td>17.3(4.4)</td>
<td>10.32(0.55)</td>
<td>1.74(0.44)</td>
<td>30.2</td>
</tr>
</tbody>
</table>

There was no significant difference between modes for VO2peak. Mean RPE, RQ and Kcal/min were significantly lower, while %Fat and Time were significantly greater at a low intensity for both modes. Mean KcalFat/min was 20-25% higher at the low intensity for SB and RS. There was also a difference for %Fat and KcalFat/min between modes with RS 20% higher at both intensities. Thus, more fat was used per minute with lower intensity exercise and when more muscle mass was used to perform the activity.

Cross-Validation of Met Prediction on the NuStep Total Body Recumbent Stepper


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A companion study (Rateike et al.) developed new regression equations to predict metabolic equivalents (METs) across a wide range of workloads on the NuStep. The purpose of this study was to cross-validate these predictions in a separate sample. Eighteen patients with either cardiac or pulmonary disease (mean age = 69.1 yrs) and 8 college students (mean age = 21.3 yrs) were used as subjects. Each subject started at either 25 or 50 Watts and increased by 25-50 Watts per stage until an RPE of 15 was reached. Each stage was 5 minutes in duration and VO2 (METs) was measured continuously. There were no significant differences between measured and predicted MET values at any of the stages or overall (measured = 3.32 METs, predicted = 3.36 METs). The correlation between measured and predicted values was $r = .94$, standard error of estimate (SEE) was .42, and total error (TE) was .44 METs. These results indicate that the newly developed prediction equations provide excellent estimates of metabolic overload and should allow cardiac and pulmonary rehabilitation professionals to prescribe workloads on the NuStep with greater accuracy and confidence.

Biomechanical Comparison of Two Lower Extremity Exercise Machines Used for Knee Injury Rehabilitation

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University of Florida, Gainesville, FL

The goals of rehabilitation after an ACL reconstruction include improving cardiovascular and muscular fitness. Although stationary bicycles are commonly used to accomplish this task, recumbent stepping ergometers have been shown to achieve the same goals. Few data exist regarding the use of recumbent steppers by individuals who have ACL surgery.

PURPOSE: To evaluate the knee joint reaction forces and lower extremity muscle activity during stepping and cycling.

METHODS: Fourteen healthy individuals with no history of lower extremity injury (age: 22.9±1.9 y, 173.6±11.3 cm, 76.7±13.2 kg) and 10 individuals who had undergone ACL reconstruction in their right knees (age: 22.2±4.1 y, 175.3±7.6 cm, 73.0±12.9 kg, 43±32 months post-op) participated. Subjects were videotaped with two cameras as they performed moderate (RPE=3) exercise on a stepper and a cycle. Four seat positions were utilized resulting in minimum knee flexion angles of 0° (full extension), 15°, 30°, and 45°. The right pedals of the stepper and bike were fitted with a load cell. Video (60Hz) and force data (900Hz) were synchronized and used to perform an inverse dynamics analysis. To assess the myoelectric activity of selected lower extremity muscles, six pairs of surface electrodes were attached to the right side of the body over the following muscles: vastus lateralis (VL), vastus medialis (VM), rectus femoris, biceps femoris, medial gastrocnemius, and soleus.

RESULTS: Statistical analyses (ANOVA) revealed that proximal/distal forces were significantly decreased for the stepper compared to the cycle (p=.029) while medial/lateral forces increased (p<.001). When compared to the cycle, significantly reduced muscle activity was detected for the VL (p=.005) and VM (p=.001) for the stepper. Significant main effects (increased muscle activity with increasing knee angle) were found in the VM (p=.012) and VL (p=.058).

CONCLUSION: Our results indicate that lower extremity biomechanics on the two machines tested are not affected by knee surgery status. The reduced compressive knee force, equal anterior shear force, and the similar muscle activity for 4 of the 6 lower extremity muscles tested, indicate that a recumbent stepper is a viable rehabilitation modality after ACL surgery.

Supported by NuStep, Inc. (UPN#01061905)

Effects of Exercise on Strength and Mobility in Residents of Assisted Living Communities: Pilot Study Trends

Johnson, T., Tietjen-Smith, T., Smith, S., & McPhee, S.

Belmont University, Nashville, TN

The purpose of the study was to examine the effects of exercise on strength and mobility in assisted living residents at Morningside Communities. Twenty residents of assisted living communities completed pre and post-testing and participated in varied amounts of exercise on a total body recumbent stepper. The physical characteristics of the residents were a mean age of 83.6 ± 7.3 years old, height of 1.59 ± .05 meters, and weight of 61.75 ± 9.9 kilograms.

The residents were divided into two groups based on the level of NuStep exercise that they logged over the test period. Group I did less than an average of nine minutes per week while Group II did an averaged of nine or more minutes per week.

Significant differences (p < 0.05) were found between groups for sitting systolic blood pressure, 15.2 M walk for time, knee extension strength, shoulder press strength, and back pull-down strength. The trends of this pilot study indicates that those who are more active maintain or improve strength and mobility while those who are less active tend to deteriorate in strength and mobility and that this effect holds true even in the oldest old individuals.