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Low Back Pain, Exercise Intensity, and Rehabilitation

Verbrugghe J, Agten A, Stevens S, Hansen D, Demoulin C, Eijnde BO, Vandenabeele F, Timmermans A. Exercise intensity matters in chronic nonspecific low back pain rehabilitation. MSSE. 2020; 51(12):2434–42.

Globally, chronic lower back pain (LBP) is the leading musculoskeletal disorder in men and women of all ages (1), and people with a lower back disability have it longer, on average, than any other disability (2). LBP is the most common cause for workplace absenteeism and burdens many health care systems (2). Only a small percentage of chronic LBP cases are caused by a specific disease or condition (1). Most clinical cases are classified as chronic nonspecific LBP (CNLBP), defined as LBP for ≥3 months with no clear pathoanatomical cause (1). Chronic nonspecific LBP is chiefly associated with pain at rest and during activities of daily living and can contribute to a reduction of aerobic exercise capacity and muscular weakness of the spine/core and hips (3,4).

Most cases of CNLBP are treated with physical rehabilitation and exercise, including low to moderate intensity aerobic exercise and occasional light resistance training (3). Indeed, rehabilitation programs are common in the management of CNLBP. However, there is little success with outcomes such as reducing pain and improving aerobic fitness and muscular strength (5), possibly due to exercise intensities that are too low. High intensity training (HIT) has been shown to improve aerobic capacity and muscular strength in healthy adults and persons managing their chronic disease and conditions when compared to moderate intensity training (MIT) (6,7). Although a lack of literature exists regarding the effects of continuous HIT on CNLBP management, some research has demonstrated similar improvements in aerobic capacity as compared to healthy adults (8). Additionally, little evidence suggests higher intensity resistance training programs (>70% 1-repetition maximum [1RM]) can be effective with improvement in quality of life, improved muscular strength of the core and limbs, and reduced LBP for persons with CNLBP (4).

HIT protocols used for aerobic and resistance training in CNLBP management vary (i.e., continuous versus interval aerobic HIT and different modes of resistance training). Furthermore, the combined effects of aerobic plus resistance HIT training for management of CNLBP does not currently exist. Therefore, the aim of this study was to compare the effectiveness of combined interval aerobic and resistance/core muscle HIT training to combined aerobic and resistance MIT training in persons with CNLBP.

MANUSCRIPT REVIEW

This randomized controlled trial included primary outcome measures of disability, pain, function, aerobic exercise capacity, and abdominal/back muscular strength in persons with CNLBP. This trial represents phase 1 of a larger study that evaluated different aspects of exercise for CNLBP management. All men and women were recruited in Limburg, Belgium, and were between 25 and 60 years old and diagnosed with CNLBP (1). Exclusion criteria included: a history of spinal fusion, a diagnosis of a musculoskeletal disease other than CNLBP, having any comorbidity or disease that precluded exercise, pregnancy, a disability/workplace compensation claim lasting >6 months, or admission to a rehabilitation program in the past 3 months.

Participants were randomly assigned to HIT (n = 19) and MIT (n = 19), which was implemented as a 12-week (24 session) exercise program of two 1.5-h sessions per week. All participants underwent baseline assessment, and pretraining and posttraining testing. Baseline measures included height, weight, body mass index, CNLBP onset, the 17-item Tampa Scale for Kinesiophobia (to measure fear of movement due to pain), and the Physical Activity Scale for Individuals with Physical Disability. Participants were assessed with the Modified Oswestry Disability Index (MODI; validated to measure degree of disability for LPB) (9), Numeric Pain Rating Score (perceived pain over the past 6 weeks on a 1–10 scale) (10), Patient Specific Functioning Scale (11), maximal cardiopulmonary cycle test (to determine VO_{2MAX}), and maximal isometric dynamometry testing for trunk flexion/extension (measure maximal torque [N·m]). All measures were repeated for pretesting and posttesting.

HIT aerobic exercise consisted of intervals of lower body cycling of 5 × 1 min of 110 rpm cycling at 100% VO_{2MAX} with recovery intervals of 1 min of 75 rpm cycling at 50% VO_{2MAX}. Cycling time increased by 10 seconds every 2 sessions up to 1 min 50 seconds with recovery intervals remaining constant. Resistance training for the HIT group included 1 set × 12 rep maximum at 80% 1RM for 6 lifts (leg curl, leg extension, leg press, chest press, arm curl, and scapular retraction). All participants completed a 1RM for each of the lifts within the second session of the exercise program. Resistance was increased by 5% of 1RM when a participant completed 10 reps of a lift within consecutive sessions. Core training consisted of 6 isometric exercises held 10 seconds for 10 reps at >60% maximal voluntary contraction and progressed to 12 seconds. For more details on core exercises and progression visit: http://links.lww.com/MSS/B669. The MIT group performed the same training as the HIT group except the intensity was reduced.

There were more women (69%) than men. Two participants (n = 1 HIT; n = 1 MIT) dropped out of the study due to non-CNLBP-related illness and exacerbation of LBP associated with the protocol, respectively. Overall, the HIT protocol was well tolerated, with no reports of adverse effects. Both groups had a significant improvement in MODI scores after the intervention, with the HIT group having 8.6% greater improvement in disability than MIT. Pain and function scores improved for both groups after exercise, with no between-groups difference. Both groups improved in VO_{2MAX} and cycle duration with larger magnitude improvements favoring the HIT group. There were no improvements for either group for isometric trunk flexion/extension.

CLINICAL IMPLICATIONS

This study assessed a combination of aerobic and resistance/core HIT compared with MIT in a group of predominantly female participants managing CNLBP. It appears that there may be additional benefits associated with HIT regarding disability and exercise capacity (VO_{2MAX}) in persons with CNLBP compared with MIT. It is also important to recognize both MIT and HIT, with the exception of isometric trunk strength, led to significant improvements in the outcome measures of this study. Study limitations included the absence of a control group and a smaller proportion of male participants, which reduces generalizability. The authors failed to perform 1RM testing at postmeasures, which would be an important indicator of improved muscular strength. The clinical exercise physiologist should consider the use of HIT programming when working with people diagnosed with CNLBP along with patient preference and appropriateness of this intensity range. Future research could focus on other modes of aerobic HIT and determine more appropriate estimates of core strength intensities.

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RECOMMENDED READING

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Stroke, Resistance Training, Autonomic Modulation, and Oxidative Stress

Bavaresco Gambassi B, Coelho-Junior HJ, dos Santos CP, de Oliveira Goncalves I, Mostrada CT, Marzetti E, Sotao SS, Uchida MC, De Angelis K, Rodrigues B. Dynamic resistance training improves cardiac autonomic modulations and oxidative stress parameters in chronic stroke survivors: a randomized controlled trial. Oxid Med Cell Longev. 2019;2019:1–12.

Stroke is a leading cause of permanent disability globally (1) and 1 of the top 4 causes of death in the United States (2), Australia (3), and Canada (4). Disability associated with stroke includes neurologic impairment (i.e., loss of muscle mass, strength, and power) that contribute to reduced physical function, quality of life, and increased disability status (1). Aside from neurologic impairment, persons who survive stroke frequently experience severe autonomic dysfunction, dysregulation of blood pressure, and marked increase in oxidative stress that can lead to increased risk of cardiovascular disease, hypertension, or another stroke (5).

A common nonpharmacologic practice associated with poststroke recovery and management is exercise. It is well documented that aerobic and resistance training is effective with the attenuation of neurologic and cardiovascular conditions (6). Specifically, resistance training can improve the neurologic deficits, mobility, physical function, and disability in stroke survivors (7). Most research focusing on resistance training uses variable resistance machinery or isokinetic dynamometers, which reduces accessibility of this mode of exercise for stroke survivors (7). Furthermore, little research deals with the effects of resistance training on autonomic function, blood pressure regulation, and oxidative stress post-stroke. Therefore, the aim of this study was to determine the impact of 8 weeks of dynamic resistance training (with the use of elastic bands) on physical function, hemodynamic and autonomic responses, and oxidative stress markers in stroke survivors.

MANUSCRIPT REVIEW

Participants for this study were recruited from a medical rehabilitation center in Poá, Brazil, who completed a post-stroke rehabilitation program and were not able to reestablish activities of daily living (ADLs) or their previous social life. Inclusion criteria were: (a) men and women 45–75 years old, (b) who were able to walk with or without ambulatory device, (c) able to perform basic ADLs according to the Barthel Index (8), (d) had a confirmed diagnosis of stroke via computed tomography or magnetic resonance imaging scan, (e) were living in the local community, and (f) completed a poststroke rehabilitation program in the last 6 months. Exclusion criteria included: (a) dependency on tobacco or alcohol, (b) current use of beta blockers, (c) uncontrolled hypertension or diabetes mellitus, (d) or any condition limiting ability to exercise.

Twenty-two participants (12 women and 10 men) were randomly assigned to a training group (TG; n = 11) or control group (CG; n = 11). Participants in the TG performed 16 sessions of dynamic resistance training with elastic bands and wrist/ankle weights for 8 weeks (2 × week with a minimum of 48 h rest between session). A series of 4 resistance exercises (seated row, chair squat, vertical chest press, and leg extension) were performed in a push/pull combination that alternated each week without any rest periods between sets. The TG completed 3 sets × 6–8 reps for each lift weeks 1–4 and then progressed to 3 sets × 10–12 reps weeks 4–8. All participants were asked to maintain a perceived intensity between 3 and 5 on rating of perceived exertion scale (1–10 RPE) for all sets of each exercise. When lower RPE was reported, the elastic band was changed to a greater resistance. Elastic bands were tied around the wrist of the paretic upper limb, and TG participants completed movement within existing range of motion. The CG performed physical therapy sessions 2 × week for 8 weeks including range of motion, gait, and balance exercises.

Primary outcome measures included functional measures (timed up and go [TUG], 10 m walk test [10mW], 5× chair sit-to-stand [5XSTS], hand grip of paretic and nonparetic limbs [PHG and NPHG]), hemodynamic parameters (resting systolic and diastolic blood pressure and double product [heart rate × systolic blood pressure]), autonomic function (heart rate variability via spectral analysis of high frequency [HF], low frequency [LF], and LF/HF ratio]), and oxidative stress markers (thiobarbituric acid reactive substances [TBARS], super oxide dismutase [SOD], and plasma nitrate analysis, a potential indicator of the ability of vascular dilatation). Premeasures and postmeasures were taken at the beginning of week 1 and end of week 8, respectively.

There were no dropouts or adverse events associated with this study. All physical function measures significantly improved for the TG after the exercise intervention. The CG did not improve with TUG, 10mW, 5XSTS, and declined in the PHG and NPHG scores. At baseline, there were no differences in resting blood pressure between groups, and neither group demonstrated improvements in resting blood pressure after the exercise intervention. The TG participants had a lower heart rate at postmeasures resulting in a lower double product. Heart rate variability parameters (LF and LF/HF) were improved with dynamic resistance training. The CG heart rate variability parameters (LF and LF/HF) worsened over the 8-week duration. Oxidative stress markers (TBARS and SOD) improved with TG participants compared with CG, with no difference in plasma nitrate between or within groups.

CLINICAL IMPLICATIONS

The findings of this study suggest that dynamic resistance training with elastic bands and wrist/ankle weights may be beneficial for stroke survivors regarding physical function, hemodynamic response, autonomic function, and oxidative stress. The improvements in autonomic function can be attributed to the faster pace of the resistance training program that did not include rest breaks and likely resulted in a greater aerobic stimulus versus more traditional and slower paced resistance training. This study also demonstrated the rapid decline associated with stroke survivors who do not engage in appropriate amounts and types of exercise. This was demonstrated by the decline in the CG handgrip scores and autonomic dysfunction. Handgrip is also a powerful clinical marker of physical function, dynapenia, and disability in adults (9).

The clinical exercise physiologist should consider incorporating dynamic resistance training when working with stroke survivors. This mode of resistance training is generally safe and easily accessible for this population and can be incorporated with home exercise programs. The findings of this study should be interpreted carefully due to the small sample size and underpowered statistical analysis. Future research is needed regarding the hemodynamic and autonomic benefits associated with resistance training with stroke survivors. Finally, future studies may also consider including measures of muscular strength for muscle groups of the upper and lower limbs.

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