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# Neuromuscular Training, Exercise Physiology Clinic, Real-time Exercise, and Cardiac Rehabilitation

Sokhangu MK, Rahnama N, Etemadifar M, Rafeli M, Saberi A. Effect of neuromuscular exercises on strength, proprioceptive receptors, and balance in females with multiple sclerosis. *Int J Prev Med.* 2021;12(5):1–6. doi:10.4103/ijpvm.IJPVM\_525\_18

The neurodegenerative nature of multiple sclerosis (MS) leads to a deterioration in muscle strength, balance, proprioception, and vision, which results in compromised motor coordination. When implementing exercise interventions for MS, one should consider the neurological challenges associated with the disease in terms of both safety and effectiveness. Comprehensive neuromuscular training incorporates a variety of modalities including core stability, strength, agility, balance, and plyometrics in an effort to optimize neuromuscular coordination. The purpose of this study was to examine if a neuromuscular exercise program would improve the strength and proprioception in those with MS.

**Methods:** Females with mild MS (1-3 Expanded Disability Status Scale) were randomly assigned to a control or intervention group. The intervention group completed a progressive neuromuscular circuit program 3 days per week for 8 weeks. The 60-minute exercise program included a 10-minute warm-up followed by 3 sets of 8 to 12 repetitions of strength, balance, agility, and core stability exercises and concluded with a 5-minute cool-down. Plyometric activities were introduced into the circuit beginning week 6. The control group was instructed to continue with normal activities and was not provided an intervention. Pre and post assessments included maximum knee strength (flexor and extensor) and proprioception senses using the Biodex System 3 Pro isokinetic dynamometer, and the Berg Balance Scale.

**Results:** The control ( $n = 10$ ) and intervention ( $n = 10$ ) groups were similar for age, height, weight, Expanded Disability Status Scale, and disease duration. The intervention group had significant improvements compared to baseline for knee extensor ( $P = 0.01$ ) and flexor ( $P = 0.04$ ) strength, proprioception ( $P = 0.004$ ), and balance ( $P = 0.02$ ), while there were no significant changes in any variable for the

control group. Additionally, significant ( $P < 0.05$ ) between-group differences (control vs intervention) was reported for all variables (strength, proprioception, and balance).

**Discussion:** Because MS impacts nearly 1 million adults in the United States and an estimated 2.8 million worldwide, addressing the motor challenges associated with MS through meaningful exercise prescription is important. The varied modalities used with neuromuscular training are thought to create a novel stressor to the nervous system, eliciting adaptations that may improve sensorimotor control. The current study provides support for the effectiveness of neuromuscular training to produce beneficial adaptations to improve strength, balance, and proprioception in patients with mild MS. Additionally, the training protocol was well tolerated by the participants. The outcomes of this study are promising. However, continued research is needed to explore the impact of neuromuscular training with a wider population, as well as evaluating program effectiveness on motor function and coordination.

Fibbins H, Edwards L, Morell R, Lederman O, Ward P, Curtis J. Implementing an exercise physiology clinic for consumers within a community mental health service: a real-world evaluation. *Front Psychiatry.* 2021;12:1–7. doi:10.3389/fpsy.2021.791125

In addition to the day-to-day impact mental illness can impose, the side effects of medications as well as unhealthy behaviors, including smoking, physical inactivity, and poor nutrition, can lead to an increased risk for cardiometabolic conditions. These factors contribute to a shorter (15-20 years) life expectancy for those with severe mental illness compared to the general population. The aim of this study was to determine the feasibility and impact of an exercise physiology clinic within a community mental health setting in Australia.

**Methods:** A small exercise physiology clinic containing minimal equipment (an exercise bike, rower, 1 set of dumbbells, and boxing and bench press equipment) was established within a community mental health center. Access to the clinic was made available 3 days a week for referred mental health case managed consumers ( $N = 483$ ), and the facility was overseen by an accredited exercise physiologist. Individualized programming, behavior modification, and monitoring was provided to participants who used the facility. Outcome assessments were conducted for body mass index, cardiorespiratory fitness determined by the Astrand-Rhyming submaximal test, and self-reported physical activity via the short-form International Physical Activity Questionnaire at baseline and every 3 months.

**Results:** Attendance at the exercise physiology clinic was recorded for 17% ( $n = 84$ ) of the eligible mental health consumers, of which 46% ( $n = 39$ ) attended for 6 months or more with an average of 17 sessions. Outcome assessments determined no significant changes in body mass index ( $n = 55$ , mean change =  $-0.01 \text{ kg} \cdot \text{M}^{-2}$ , 95% CI  $-0.88, 0.86$ ;  $P = 0.98$ ) or cardiorespiratory fitness ( $n = 32$ , mean change =  $1.7 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ , 95% CI  $-0.4, 3.8$ ;  $P = 0.12$ ); however, questionnaire outcomes indicated a significant increase in moderate-to-vigorous physical activity ( $n = 29$ , mean change =  $74.2 \text{ min} \cdot \text{wk}^{-1}$ , 95% CI  $31.9, 116.6$ ;  $P < 0.001$ ) and a significant decrease in daily sedentary time ( $n = 29$ , mean change =  $-1.6 \text{ hr} \cdot \text{d}^{-1}$ , 95% CI  $-2.4, 0.71$ ;  $P = 0.001$ ).

**Discussion:** The expansion of mental health centers to incorporate exercise physiology services is a novel concept. Despite limited resources, the current study provided support for the feasibility of integrating an exercise clinic into a health center serving those with severe mental illness. Although not all outcome measures improved, it is important to recognize that improvements were noted, including a reduction of daily sedentary time and an increase in moderate-to-vigorous physical activity. Integrating exercise services within a community mental health care setting may offer additional benefits for factors including mental health and quality of life. However, these were not evaluated in this current study. Continued efforts should be made to support those with mental illness and determine best practices for expanding exercise-based services.

Chung WP, Yang HL, Hsu YT, Hung CH, Liu PY, Liu YW, Chan SH, Tsai KL. Real-time exercise reduces impaired cardiac function in breast cancer patients undergoing chemotherapy: a randomized controlled trial. *Ann Phys Rehabil Med*. 2021;65(2):101485. doi:10.1016/j.rehab.2021.101485

Breast cancer is a leading cause of death in women between the ages of 45 and 65. One of the most common cancer treatments includes anthracycline drugs. This class of chemotherapy is associated with a reduction in functional capacity, and an increased risk of cardiovascular disease and congestive heart failure. Exercise may help alleviate the deleterious

effect of cancer treatment, with potentially greater benefits observed with high-intensity activity compared to moderate-intensity training. Chung et al investigated the use of high-intensity aerobic and resistance exercise training on cardiopulmonary function in women with breast cancer undergoing anthracycline chemotherapy.

**Methods:** Thirty-two women were recruited to participate and were assigned randomly to a control (CON:  $n = 16$ ) or an exercise group (EX:  $n = 16$ ). EX accumulated 24 supervised training sessions over 3 months, consisting of 40 minutes of aerobic exercise, 15 minutes of resistance exercise, and 5 minutes of flexibility training. Aerobic exercise was performed either on a stationary cycle or treadmill and began with a 5-minute warm-up at 50% heart rate reserve (HRR), rate of perceived exertion 11, or 50% to 60%  $\text{VO}_{2\text{peak}}$ , followed by 30 minutes at 70% to 80% heart rate reserve, rate of perceived exertion 13 to 14, or 70% to 75%  $\text{VO}_{2\text{peak}}$ . A 5-min cooldown used the same intensity as a warm-up. Workload intensity was established via a cardiopulmonary exercise test using the Bruce ramp protocol on a cycle ergometer. A cardiopulmonary exercise test was completed at Baseline, 1.5, 3, and 6 months. Cardiac function was determined using M-Mode, 2-D, and tissue Doppler echocardiography at baseline, 3, 6, and 12 months by experienced echocardiographers blinded from the study design and clinical data.

**Results:** Please note that because of the high number of echocardiographic variables measured, the current summary will include the most influential data. Moderate-to-high intensity exercise reduced exercise capacity decline, as shown by  $\text{VO}_2$ . From 1.5 months to 6 months, CON showed decreased  $\text{VO}_2$  ( $P = 0.029$ ), while at 6 months, EX increased  $\text{VO}_2$  compared to CON ( $P < 0.05$ ). Left ventricular ejection fraction was significantly decreased in CON at 12 months compared to EX, and significantly different in comparison to baseline ( $P < 0.05$ ). Cardiac hypertrophy was reduced in EX compared to CON, indicated by the significant differences in left ventricle mass at end-diastole, intraventricular septum thickness at end-diastole, and left ventricle mass index (LVMI). CON significantly increased left ventricle mass at end-diastole at 3 months compared to baseline ( $P < 0.05$ ). EX left ventricle mass at end-diastole was reduced at 12 months compared to baseline ( $P < 0.05$ ), and significantly lower at 3, 6, and 12 months compared to CON ( $P < 0.05$ ). Intraventricular septum thickness at end-diastole was significantly lower in EX compared to CON at the 12-months follow-up ( $P < 0.05$ ) and was significantly decreased at 6 and 12 months compared to baseline ( $P < 0.05$ ). Left ventricle mass index was lower in EX compared to CON at 3 and 12 months ( $P < 0.05$ ).

**Discussion:** This paper provides promising results suggesting moderate-to-high intensity exercise may be part of a strategy to mitigate the development of cardiac dysfunction associated with anthracycline-based chemotherapy in women with breast cancer. Reductions in left ventricular ejection fraction in CON, but not EX, may indicate a positive effect of moderate-to-high exercise in mediating the

development of cardiac dysfunction observed during early phase chemotherapy. Myocardial mass measurements are important predictors of congestive heart failure in patients without a previous myocardial infarction. The reductions observed in intraventricular septum thickness at end-diastole, left ventricle mass at end-diastole, and left ventricle mass index following exercise support moderate-to-high intensity exercise to prevent cardiac hypertrophy and remodeling which may result in myocardial dysfunction progression as observed in the CON group.

Regan EW, Handlery R, Stewart JC, Pearson JL, Wilcox S, Fritz S. Integrating survivors of stroke into exercise-based cardiac rehabilitation improves endurance and functional strength. *J Am Heart Assoc.* 2021;10(3):e017907. doi:10.1161/JAHA.120.017907

A reported 58% of stroke survivors fail to meet physical activity guidelines. With rehabilitative priority placed on the functional limitations associated with activities of daily living, such as gait-reeducation, mobility, and balance, cardiovascular exercise interventions are often deemphasized. Regan et al examined the impact of a cardiac rehabilitation (CR) program in stroke survivors on cardiovascular endurance, functional strength, and walking speed, in addition to other emotional health parameters like quality of life, balance confidence, and depression. The researchers also examined the program's impact on physical function, health, and future physical activity participation.

**Methods:** Twenty-nine stroke survivors were recruited for the study, following the initial study screening. The CR program costs were covered by grant funding. Preprogram 6-minute walk tests (6MWT) were used to determine baseline maximum metabolic equivalents of task and target heart rates for personalized activity plans. CR participation included 3 sessions per week, for 12 weeks, incorporating aerobic exercise for 31 to 50 minutes. Optional strength, flexibility, and/or relaxation activity were also available at each session. Outcome measurements included the 6MWT, the 10MWT, the stroke impact scale, and maximal metabolic equivalents of task. Stroke impact scale included the following subscales: (a) mobility, (b) activities of daily living, (c) participation, (d) hand function, (e) strength, (f)

communication, (g) emotion, and (h) memory/thinking. Function lower body strength was examined using the 5-times sit-to-stand test. Participants were reassessed immediately and 6 months following program completion. The activities-specific balance confidence scale, the short self-efficacy for exercise scale, the short outcome expectations for exercise scale, and the patient health questionnaire-9 were also used.

**Results:** Twenty-four individuals completed the protocol, 6 of which were unable to attend the 6-month follow-up because of: 1 declined, and 5 were impacted by the coronavirus disease and facility closures. From pre to post CR, participants improved the 6MWT by an average of 62m ( $P < 0.001$ ) and the maximum metabolic equivalents of task by a median of 3.6 ( $P < 0.001$ ). A significant improvement was observed for pre to post mean 6MWT distance (72 m change; 95% CI, 26-117 m;  $P = 0.002$ ) improvements were unchanged at 6-month follow up, but significantly different than preprogram (67 m change; 95% CI, 13-120 m;  $P = 0.013$ ). A 6.9% improvement in stroke impact scale-mobility was observed from pre to post program ( $P = 0.008$ ) but was not maintained at the 6-month follow-up. Compared to preprogram values, a significant ( $P < 0.001$ ) post program improvement was noted (2.9 s) in 5-times sit-to-stand test, which was maintained at the 6-month follow-up. Program participation improved the perception of physical appearance, positive medication changes, and importance of health interventions, as 83% of participants reported continued exercise at the 6-month follow-up.

**Discussion:** Stroke survivor participation in CR resulted in improvements in cardiovascular endurance, functional strength, perceived mobility, and maintenance of performance at the 6-month follow-up. Improving 6MWT, maximal metabolic equivalents of task, and sit-to-stand scores are associated with reductions in all-cause mortality and fall risk, and improvements in exercise capacity and activities of daily living. Despite no effect of CR on mood or outlook, several participants mentioned improvements in emotional health, reduced depression, positive attitude, and self-perception. Exercise-based CR appeared to influence participant perception of home and community mobility, walking capability, and emotional health. These findings support the use of CR in stroke survivors following functional limitation rehabilitation to improve and maintain physical and mental health, as observed by the improvements in cardiovascular endurance, strength, and perception of quality of life.