Acta Fisiatr. 2018;25(2):102-106

Assistance protocol of physical fitness departments for individuals with neuromuscular and musculoskeletal diseases

Protocolo de assistência do serviço de condicionamento físico para indivíduos com doenças neuromusculares e musculoesqueléticas

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ABSTRACT

Physical fitness supervised by Physical Education professionals inserted in a rehabilitation program for patients with neuromuscular and musculoskeletal disorders aims to increase muscle strength, improve motor coordination, dynamic balance, aerobic capacity, functional capacity and health-related physical fitness. This is an important intervention to prevent and mitigate the synergy between loss of physical function and exacerbation of various comorbidities that compromise functional independence, modify risk factors, increase quality of life and longevity with reduced mortality. The aim of this paper is to present the assistance protocol of the Physical Conditioning Service of the Institute of Physical Medicine and Rehabilitation of the Clinical Hospital of the University of São Paulo Medical School (IMREA-HCFMUSP), designed for the intervention of physical exercises, respecting the profile and physical limitations of these patients, as well as observing their clinical markers.

Keywords: Neuromuscular Diseases, Musculoskeletal Diseases, Physical Fitness, Exercise

RESUMO

O condicionamento físico supervisionado por profissionais de Educação Física inserido em um programa de reabilitação para pacientes com distúrbios neuromusculares e musculoesqueléticos visa o aumento da força muscular, melhora da coordenação motora, equilíbrio dinâmico, capacidade aeróbia, capacidade funcional e da aptidão física voltada à saúde. Trata-se de importante intervenção para prevenir e atenuar a sinergia entre a perda de função física e a exacerbação de várias comorbidades que comprometem a independência funcional, modificar fatores de risco, aumentar a qualidade de vida e longevidade com redução da mortalidade. O objetivo desse artigo é apresentar o protocolo de assistência do Serviço de Condicionamento Físico do Instituto de Medicina Física e Reabilitação do Hospital das Clinicas da Faculdade de Medicina da Universidade de São Paulo (IMREA-HCFMUSP), elaborado para que a intervenção de exercícios físicos seja adequada, respeitando o perfil e limitações físicas desses pacientes, bem como na observação de seus marcadores clínicos.

Palavras-chave: Doenças Neuromusculares, Doenças Musculoesqueléticas, Aptidão Física, Exercício

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Submitted: May 5, 2018.
Accepted: October 26, 2018.

How to cite
Cardoso CV, Mota CG, Sampaio ICSP, Sabbag LMS. Assistance protocol of physical fitness departments for individuals with neuromuscular and musculoskeletal diseases. Acta Fisiatr. 2018;25(2):102-106.

DOI: 10.11606/issn.2317-0190.v25i2a162579

INTRODUCTION

The fitness program aims to promote neuromuscular and musculoskeletal adaptations with positive impact on motor control associated with physical disability. By working in the physical rehabilitation process, the program incorporates guidelines designed to promote low-risk treatment, which must be prescribed and monitored individually in order to improve the functional capacity of patients with major disabilities.

It was necessary to elaborate an assistance protocol to standardize the activities of physical educators in the care of different populations with chronic disabilities secondary to neuromuscular and musculoskeletal diseases, with different symptoms, functional capacity and rehabilitation strategies. This guideline-based program clearly defines the limits and care in the physical and functional assessment, prescription and intervention of aerobic and resistance training, broadening the approach to the following diseases: brain injury, spinal cord injury, amputation, Parkinson's disease, multiple sclerosis, Guillain Barré syndromes, and post-polio, muscular dystrophies, myopathies, and hemophilia.

A bibliographic review of papers and books published from 1991 to 2011 was performed in the scientific databases LILACS, Scielo and Pubmed, in Portuguese and English, using the words neuromuscular diseases and physical conditioning as descriptors and using reference textbooks for health fitness assessment. The data were analyzed and thus determined the following theoretical assumptions about physical fitness.

Pre-Activity Evaluation

The Physical Fitness program for individuals with chronic disability contains several distinct steps aimed at minimizing the risks before the patient is released for exercise intervention, since patients with severe disability may have comorbidities such as coronary insufficiency, arterial hypertension, systemic disease and diabetes mellitus among others. A logical and practical sequence was adopted to gather and evaluate health information about the patient.[1]

The first stage of the pre-activity assessment is the anamnesis, where personal information is collected from the individual such as full name, educational level, as well as health and exercise history. Risk stratification is the second stage of pre-activity assessment; it is used to obtain current information about current health status and to classify patients into three risk categories, low, moderate and high. This stage provides a basis for Cardiac assessment recommendation, in which all patients stratified as moderate and high risk are referred for cardiological medical evaluation.[1] Cardiac medical evaluation includes resting electrocardiogram (ECG), complementary exams if necessary, when possible, some exercise stress test or cardiopulmonary exercise test for detection of heart disease, cardiorespiratory performance and aerobic training prescription. Only after the completion of these steps the patient performs physical evaluation with the physical educator.

Method evaluation

In the construction of the assessment method, it was decided to evaluate the health-related physical fitness. There are several definitions of health-related physical fitness, however the most relevant terminology for the public concerned is that offered by the Centers for Disease Control and Prevention, "Physical fitness is a set of attributes that people possess or acquire and that relates to the ability to perform physical activity.[2]

Health-related physical fitness focuses on functional capacities related to overall good health and disease prevention, so its main components are cardiorespiratory fitness, muscle fitness, lumbosacral and posterior thigh musculature flexibility, and body composition.2

There are several tests for each of the four components of health-related physical fitness; in the choice of tests it was taken into account the specific population of patients with major motor disabilities attending this institute, the ease of administration of the test and the comparison of data.[3]

The tests were divided into tests performed at rest; blood pressure (BP), heart rate (HR), Dextro, weight and height and tests performed during exercise; physical fitness test and functional capacity tests.

The BP, HR and Dextro OGT verification is performed before each fitness session by the nursing staff, as the results directly affect the decision making about the convenience of performing or not any activity on that day. Periodicity of weight and height reassessments and tests performed during exercise occur every three months.

Among the many tests performed in exercise to determine health-related physical fitness, those that match the residual motor function of these patients were selected. The flexibility of the lumbosacral region and the posterior thigh muscles is performed using the sit-and-reach test on the Wells bench.[2] For muscle fitness the 10 repetition maximum test and the Borg scale maximum repetition test was used.[1,3] For cardiorespiratory fitness, the 6-minute walk test is applied, if the patient is wheelchair-bound, the 12-minute wheelchair test is used, only with patients at low risk for cardiovascular disease, an exercise test performed by the cardiology service in the laboratory.[1, 4.5]

Body composition (BMI) is used;[2] in functional evaluation, the functional ability to sit and stand up in the chair is verified in the five-repetition test or the 30-second test.[6] Dynamic balance is assessed in the Time Up and Go test.[7]

And physical exercise

Physical exercise in the rehabilitation program aims to enable patients to achieve physiological and psychological benefits through controlled risk activities. Based on the guidelines of the American College of Sports Medicine (ACSM), the combined Fitness program was built, which includes aerobic training, muscle endurance and joint flexibility. This type of well-designed program promotes cardiovascular adaptations, increases muscle strength, reduces body fat and increases basal metabolic rate.[1]

Intervention with aerobic exercise

The prescription of the aerobic exercise program is performed individually, based on the cardiological medical evaluation, for those who were or not submitted to stress test.

The physiological adaptations induced by aerobic training depend mainly on the intensity of overload. There are several different ways of prescribing and stating exercise intensity; in this protocol three different forms are used, the percentage of the maximum heart rate (HR_{Max}) obtained by the exercise stress test or the ergospirometric test, the maximum heart rate (HR_{Max}) obtained by the Age or Perceived Effort Taxation (PTE).[1]

The initial intensity of aerobic training takes into account the patient's initial level of aerobic fitness; it is prescribed from mild to moderate, that is, the training heart rate

(HRt) is 60% to 80% of HR_{Max}, obtained in a test using the Karvonen's exercise formula for the calculation.[8]

In the absence of the stress test, the exercise intensity may be controlled by FCt of 60% to 80% HR_{Max} obtained by age using the Tanaka's formula.[5] Except for patients using beta-blockers and/or non-dihydropyridine calcium channel inhibitors.[5] For these patients not submitted to the stress test, Perceived Effort Taxation (PTE) 11 - 13 on the Borg Scale is used.

The Perceived Effort Taxation (PTE) by the Borg Subjective Scale is a psychophysiological approach, where the person who is exercising rates the perceived sensations regarding the level of effort on a numerical scale. The enhancement and the adjustment of the toe during exercise provides an effective way to prescribe aerobic exercise without being from the maximum heart rate achieved in the stress test or age but from the perception of effort by the individual that matches the objective measures of physiological/metabolic overload such as% HR_{Max} % of $VO2_{Max}$ and lactate concentration.[10]

The frequency of aerobic training can be two to three times a week, lasting 20 to 30 minutes.[1] The most commonly used types of exercise are pedaling on a lower limb cycle ergometer, walking with or without obstacles (neuromuscular training), interval training, wheeled transport, continuous extension and flexion movements of the shoulders and flexion of the elbows and alternating arms with elastic tensioners.[3] The physical educator should handle the load of the equipment used and/or its speed. The pace of walking should also be controlled in order for the patient to perform his aerobic training within the prescribed minimum and maximum HRt .

HRt control is performed by palpation of the radial pulse every 10 minutes. For patients without HRt, HR and PTE are recorded by the Borg Scale every 10 minutes to control the intensity of aerobic training. After the end of the aerobic exercise, wait for the patient's HR recovery by imposing a lower intensity or just sitting, for at least two minutes and a maximum of five minutes and make a new measurement.

Usually patients with very low initial aerobic fitness, in the first sessions of aerobic exercise, will always suffer from peripheral fatigue either in lower limbs or upper limbs before expected central fatigue occurs, so aerobic exercise should progress from short sessions of 5-10 minutes of low and/or moderate intensity, alternating with active periods of recovery, that is, aerobic exercise at an interval.[3]

Intervention with resistance exercise

The effectiveness of a resistance training program depends on some factors such as intensity, training volume, and frequency. In developing the resistance training prescription protocol, it was considered what constitutes an optimal balance of these variables to maximize benefits, always taking into account individual needs such as motor sequelae type, age, health status, fitness level, reasons for training and personal goals.

To improve muscle strength and endurance, it was based on the intensity of resistance exercise that allows the individual to complete 8 to 12 repetitions per set, performed comfortably. This equates to the moderate intensity of 60% to 75% of a maximum repetition. With training volume in which each of the main muscle groups should be trained one, two or three series with a number of eight to ten exercises, for patients who walk and for wheelchair users from five to eight exercises per fitness session.[4,11]

The attendance rate was two to three times a week with at least 48 hours between training sessions. The loading progression should be made slowly while the patient adapts to the 1 kg to 2 kg program for upper limbs and 2 kg to 4.5 kg for lower limbs. After this period the progression should increase the load by 5% when the patient can comfortably perform 12 to 15 repetitions or when the patient reports a PTE below 11 on the Borg Scale during an exercise.[3]

Patients who do not have good grip strength may use elastic tensioners, elastic bands, or Velcro belts to secure their hands to dumbbells or weight equipment.[4] In Spinal cord injuries one should give special attention to muscle imbalance and prevention of repetitive overload injuries. The antagonistic muscles of wheelchair propulsion should be strengthened and the agonists must be stretched. Stabilization of the trunk should be done by belts or straps, if necessary, tie their hands on the apparatus or dumbbells so that the patients do not have their performance reduced. Emphasize the strengthening of shoulder stabilizers.[3]

For Hemiplegic Patients whenever possible exercise the hemiplegic/hemiparetic upper limb, as exercise is very effective in treating spasticity, as it promotes neuroplasticity and improves elasticity in muscle and connective tissues.

Shoulder pain is common in patients with hemiplegia/hemiparesis, so be very careful when prescribing exercises for this muscle group. Avoid horizontal abduction from shoulder greater than 60º and avoid performing exercises should there is any pain. Often these patients will project their body during the series toward the weaker side to compensate for this weakness. Make sure the patient uses the appropriate technique.[4]

In amputated patients, emphasis should be given to the trunk, gluteus and upper thigh muscles, as this region is one of the most important for ambulation in this population, which requires strength gain and range of motion.[3] In patients with coordination deficit, give preference to exercises on machines, because the movement can be controlled offering less risk to the individual.

Recommendations and care

Moderate physical exertion carries a small risk of sudden death during activity, but this risk has declined greatly over the past 25 years, even as the number of people who have begun to exercise has increased.

To decrease the likelihood of exercise-related complications, some special conditions should be closely observed in the clinical setting.[1]

Before starting the fitness session, it is important to get information about the individual's physical and emotional state such as, if you have been using your medications properly, feeling well or tired at that time, if there is anything to report regarding the previous session as pain, muscle or excessive fatigue and also their health (Chart 1). Performance during the exercise session is totally related to these factors.[1,2]

The Brazilian Society of Cardiology Hypertension and Nephrology recommends that in hypertensive individuals the training session should not be started if systolic blood pressure (SBP) and diastolic blood pressure (DBP) are above 160 and/or 105 mmHg respectively.[5]

For this protocol, the institution's cardiology service realized the need to reduce these blood pressure parameters to 150 mmHg for SBP and 100 mmHg for DBP for patients with a history of cardiorespiratory or cardiovascular events, as well as making recommendations for decision making when to perform or not the fitness session (Chart 2).[12]

Chart 3 presents some recommendations for session interruption if the patient presents certain signs or symptoms that require an evaluation by the nursing and / or medical team.[1 2]

Diabetic patients should have their blood glucose monitored before, during and after exercise. Blood glucose levels below 100 mg/dl and above 250 mg/dl contraindicates physical exercise. Other recommendations are also required as described in Table 2.[1 2]

Patients with T1-T6 spinal cord lesions experience autonomous dysreflexia, precarious thermoregulation and orthostatic hypotension. Respiratory capacity is further reduced due to the paralysis of the intercostal muscles.

During exercise, autonomic dysreflexia results in increased catecholamine release that will increase HR, VO2, blood pressure (BP) and the individual's ability to exercise. In some circumstances, BP may be elevated to levels high enough to produce a stroke (SBP 250-300 mmHg or DBP 200-220 mmHg).[3] For this reason, it is necessary to measure blood pressure before starting the exercise session.

Recommendations and cautions for dysreflexia are described in Table 5 and include some calculation to determine the mean BP of these patients.

CONCLUSION

Participation in a fitness program in the rehabilitation of people with neuromuscular and musculoskeletal disorders focuses attention on understanding the mechanisms by which exercise improves health, physical fitness, and the potential for rehabilitation. This protocol elucidates several clinical applications of physical exercise intervention that may positively influence patient health.

In the clinical setting, the physical educator should act in such a way as to improve the overall physical fitness of the patient, especially with regard to muscle strength, cardiorespiratory fitness and balance, thus providing better quality of life and autonomy for these individuals.

Chart 1. Recommendations5 in making a decision about whether or not to do a fitness session

Asymptomatic hypertension		
equal to or above 150x100 mmHg	Patients with a history of cardiorespiratory, cardiovascular and vasculopathy diseases ;	Dismiss the patient from the session on this day;
Symptomatic hypertension		
equal to or above 150x100 mmHg	Patients with a history of cardiorespiratory, cardiovascular and vasculopathy diseases ;	Dismiss the patient from the session and refer the nursing staff;
Asymptomatic hypertension		
equal to or above 160x100 mmHg	Patients with no history of cardiorespiratory, cardiovascular and vasculopathy diseases ;	Dismiss the patient if after 15 minutes of mild aerobic exercise the BP is maintained or elevated;
Symptomatic hypertension		
equal to or above 160x100 mmHg	Patients with no history of cardiorespiratory, cardiovascular and vasculopathy diseases ;	Dismiss the patient from the session and refer the nursing staff;
Asymptomatic hypertension		
equal to or above 150x95 mmHg	Patients with a history of cardiorespiratory, cardiovascular and vasculopathy diseases ;	Dismiss the patient if after 15 minutes of mild aerobic exercise the BP is maintained or elevated;

Chart 2. Recommendations[13] and exercise care for diabetic patients

• Do not apply insulin to the area that will be heavily requested during exercise;
• Adjust the dose and type of insulin under medical guidance to perform the exercise;
• Check the need to increase carbohydrate intake before and after exercise;
• Always have a carbohydrate source for immediate use during or after exercise;
• At the first sign of hypoglycaemia, stop exercising and eat carbohydrates;
Exercise care for diabetics in the presence of chronic complications:
• Retinopathy: Avoid exercises that greatly increase systolic blood pressure or require Valsalva's maneuver;
• Nephropathy: Avoid high intensity exercise due to increased proteinuria ;
• Peripheral neuropathy: wear silicone insoles, seamless cotton socks, examine feet after exercise and, in more severe cases, prioritize exercises that do not require body weight support, eg. pedaling;
• Autonomic neuropathy: avoid exercises that require a sudden change of position and exercises at extreme temperatures;

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Chart 3. Recommendations[5] and exercise care for spinal cord injury patients

Recommendations
For patients with spinal cord injury above the T6 level, monitor BP regularly (beginning, middle and end), aerobic exercise and resistance exercise; the patient's resting BP must be less than or equal to his average BP to be released to initiate the CF session.
PA media is identified as follows:
Verify resting BP in the first three sessions of FC; sum up the results obtained from SBP and divide by the number of results; Add the results of DBP and divide by the number of results; The value obtained in this equation will be the average BP of the patient.
Actions and deviations if patient presents with BP alteration
If patient reports to the service:
With suspected dysreflexia : add 20mmHg to the patient's average BP, if the resting BP is less than the average BP + 20mmHg the session should be continued normally; if greater than or equal to mean BP + 20mmHg, dismiss the patient and refer them to the nursing service for evaluation.
No suspicion of dysreflexia : add 30mmHg to patient's average BP, if resting BP is less than average BP + 30mmHg the session should be continued normally, if greater than or equal to average BP + 30mmHg, dismiss the patient and refer him / her to the nursing service for evaluation.
Even asymptomatic quadriplegics, if systolic BP greater than or equal to 140 and / or diastolic BP greater than or equal to 90, discontinue therapy and refer to the nursing station for medical evaluation, and even asymptomatic spinal cord injured patients if systolic BP greater than or equal to 150 and / or diastolic BP greater than or equal to 100, discontinue therapy and refer to the nursing station for medical evaluation.
In case of increased SBP and DBP, with symptoms such as bradycardia, sweating, throbbing headache, facial flushing and nasal congestion, you should sit with a vertical spine to reduce BP and identify and remove the irritant stimulus. If necessary, discontinue exercise immediately, refer patient to nursing service.
Care
Aerobic exercise should progress from short sessions of 5 to 10 minutes of moderate intensity, alternating with active 5-minute recovery periods.
If you have exercise-induced orthostatic hypotension: reposition your chair to a slanted position (head lower than your feet), or lie down with your legs raised; If there is no improvement, refer to the nursing station for medical evaluation. In wheelchair patients emphasize stretching of the wheelchair propulsion agonist muscles (anterior and pectoral shoulder muscles) and antagonists should be strengthened (posterior shoulder and upper back muscles);
Avoid factors that reduce heat tolerance such as loss of sleep, alcohol, infectious disease, dehydration and lack of acclimatization.

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