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Effects of concurrent training on muscle strength in older adults with metabolic syndrome: A randomized controlled clinical trial

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ABSTRACT

Introduction: Metabolic syndrome is highly prevalent among older adults. Concurrent training comprises muscle strengthening and aerobic exercise.
Objective: Determine the effects of a concurrent training program on muscle strength, walking function, metabolic profile, cardiovascular risk, use of medications and quality of life among older adults with metabolic syndrome.
Methods: A randomised, controlled, blind, clinical trial was conducted in the city of Santos, state of São Paulo, Brazil, involving 41 male and female older adults. The participants were randomly allocated to a control group (n = 18) and intervention group (n = 23) and were submitted to the following evaluations: strength – 1 maximum repetition (1MR) for 12 muscle groups; the Six-Minute Walk Test (6MWT); blood concentrations of cholesterol and glucose; the use of medications; and the administration of the SF-36 questionnaire. The intervention was conducted twice a week over a total of 24 sessions of concurrent training: 50 min of strength exercises (40–70% 1MR) and 40 min of walking exercises (70–85% maximum heart rate).
Results: Increases in muscle strength were found in the upper and lower limbs in the inter-group analysis and a greater distance travelled on the 6MWT was found in the intervention group (p = 0.001). The intervention group demonstrated a reduction in the consumption of biguanides (p = 0.002). No changes were found regarding metabolic profile, cardiovascular risk or self-perceived quality of life.
Conclusion: The findings of this clinical trial can be used for the prescription of concurrent training for older adults with metabolic syndrome for gains in muscle strength and walking distance as well as a reduction in the use of biguanides.

1. Introduction

Metabolic syndrome (MS) is a complex, physiopathological disorder that involves interactions among the environment, genetic susceptibility, insulin resistance and abnormal adipose tissue function (Olde, Alpert, & Dalusung-Angosta, 2013). The prevalence of this condition increases with age due to the fact that the ageing process triggers hormonal changes, an increase in visceral obesity, greater insulin resistance, dyslipidemia and systemic inflammation (Dontsov & Vasil'eva, 2013). The prevalence of MS among Brazilian older adults is high (54.8%) in comparison to other countries (Saad, Cardoso, Martins, Velarde, & Cruz Filho, 2014).

A change in lifestyle among individuals with MS through the practice of exercise has demonstrated improvements in insulin-induced vascular dysfunction, systemic inflammation (Vinet et al., 2015) and the lipid profile as well as a reduction in abdominal obesity (Yoo, Kim, & Song, 2013). Concurrent training is an exercise modality that employs resistance exercises and aerobic exercises in a single session (Powell, Paluch, & Blair, 2011). Despite increasing muscle strength in older adults, the debate continues on neuromuscular adaptations in comparison to strength training alone (Cadore et al., 2013). Blood concentrations of fasting glycemia, glycated haemoglobin and impaired

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glucose tolerance are reduced in adults following concurrent training (Libardi, de Souza, Cavaglieri, Madruga, & Chacon-Mikahil, 2012).

Despite the known benefits, a recent literature review suggests considerable variety in the prescription of concurrent training, which hinders the dose-response standardisation (intensity, duration, frequency and volume of exercises) for the population of older adults (Cadore & Izquierdo, 2013), thereby impeding definitive conclusions regarding the efficacy of this exercise modality.

Due to the lack of conclusions with regard to concurrent training and the high prevalence of MS among older adults in Brazil, the aim of the present study was to investigate whether 12 weeks of a concurrent training protocol would improve muscle strength and waking function in older adults with MS. A further aim was to determine whether concurrent training would lead to a reduction in anthropometric measures as well as improvements in the lipid profile, fasting glucose, glycated haemoglobin, cardiovascular risk and self-perceived quality of life, along with a reduction in the use of medications.

2. Methods

2.1. Study design

This randomised, controlled, blind, clinical trial received approval from the Human Research Ethics Committee of the Federal University of São Paulo (Brazil) under process number 288.404 and is registered with the Brazilian Registry of Clinical Trials of the Ministry of Health (n° RBR-9bnx9m).

2.2. Participants

Forty-one male and female volunteers between 60 and 79 years of age participated in the study. All volunteers had a diagnosis of MS according to the National Cholesterol Education Program III (NCEP, 2001), classified with three or more of the following: diagnosis of systemic arterial hypertension; fasting glycaemia ≥100 mg/dl; triglycerides (TGs) ≥150 mg/dl; abdominal circumference ≥94 cm for men and ≥80 cm for women; and high density lipoprotein (HDL) ≤ 40 mg/dl for men and ≤50 mg/dl for women.

Individuals were excluded from the study in two phases. Fig. 1 lists the reasons for exclusion in both phases. One hundred twenty-one individuals were excluded during the recruitment phase: nine for declining to participate in the study; eight based on age; 38 for having only systemic arterial hypertension; 19 for having only type II diabetes mellitus; three for severe obesity with limited mobility (Mini Nutritional Assessment questionnaire used to detect severe obesity and malnutrition); four for being smokers or ex-smokers for whom the time elapsed since quitting was less than 20 years; two for nephropathy; one for lung disease; six for heart disease (heart failure and arrhythmia); four for orthopaedic restrictions, such as symptomatic arthrosis and acute low back pain; one for cancer; one for cognitive impairment (Mini Mental State Examination); seven for taking insulin shots (patients with more severe diabetes and greater chance of clinical decompensation in glucose metabolism); one for having suffered a stroke; 11 for having a high level of physical activity (performed other types of exercises – measured using the short form of the International Physical Activity Questionnaire); and six due to the distance from the gym to their home. Six participants were lost in the follow-up phase: three from the control group [two who suffered trauma (hand fracture and acute exacerbation of knee arthrosis) and another who began physical exercises without recommendation] and three from the intervention group (two for giving up the practice of the exercises and one for developing heart arrhythmia after a family conflict and having received medical advice to drop out of the study for a clinical investigation of the case).

2.3. Intervention

The volunteers in both groups participated in an adaptation phase, which comprised four meetings at a gym of the Federal University of São Paulo, the aim of which was to familiarise all participants with the muscle strengthening machines and treadmill. The volunteers performed ten minutes of exercise on a treadmill (*Movement*, model RT 250) with a mean velocity of 4 km/h and also performed a set of 10 load-free repetitions of the following exercises: bench press (*Mettal Biodelta,* model CA 1013), bilateral knee extensor (*Cybergym Smart,* model CP 203), bilateral reverse fly (*Cybergym Smart,* model CP 204), unilateral right and left knee flexor (*Cybergym Smart*, model CP 264), bilateral seated rowing (*WCT Fitness*, model 021), bilateral hip abduction (*Cybergym Smart,* model CP 208), bilateral front pull-down (*WCT Fitness*, model 021), bilateral hip adduction (*Cybergym Smart,* model CP 213), bilateral triceps pulley push-down (*WCT Fitness*, model 021),

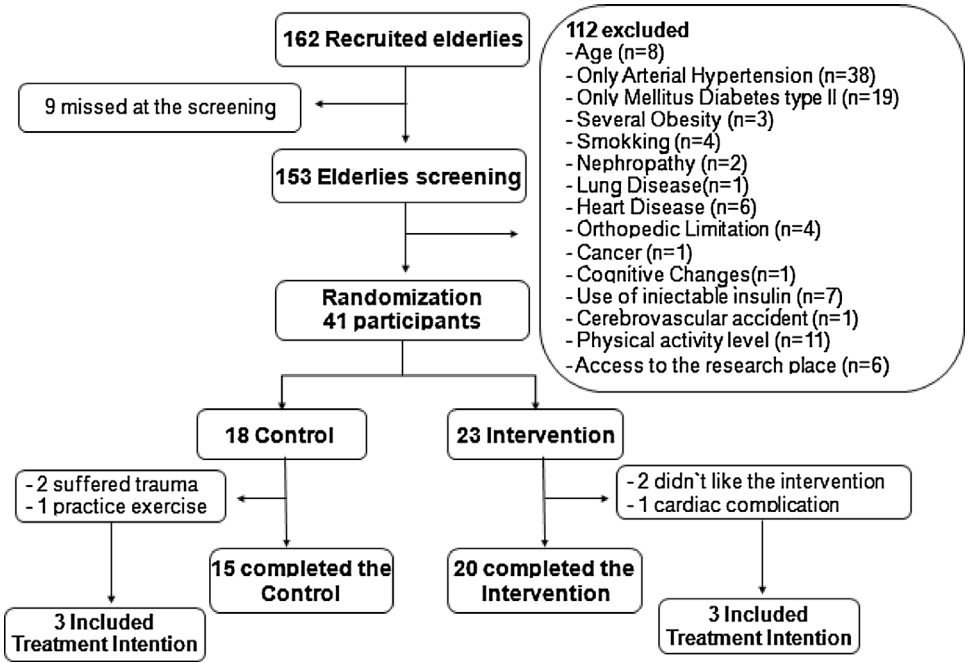

Fig. 1. Study Flowchart.