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Comparison of the effect of multicomponent and resistance training programs on metabolic health parameters in the elderly

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ABSTRACT

Physical activity interventions such as resistance training (RT) and multicomponent (MCT) exercise training are known to improve functional mobility and reduce the risk of disability among the elderly. Less evidence exists regarding the effectiveness of such exercises to improve metabolic risk factors for age related conditions.

This study aimed to compare the effects of MCT and RT programs on metabolic health parameters in healthy elderly.

Methods: Twenty one and 18 subjects completed a 12-week MCT and RT program respectively. Before and after intervention, body composition, functional ability, aerobic fitness and metabolic health parameters including lipid profile, inflammatory markers, glucose metabolism, hormones and growth markers were examined.

Circulating concentrations of epidermal growth factor increased significantly in the MCT group from 35.8 ± 29.4 to 56.1 ± 35 pg/ml. High molecular weight adiponectin decreased significantly in the RT group from 4.7 ± 2.9 to 4.2 ± 2.3 μg/ml ($p = 0.03$). No other biochemical parameter was significantly altered within either group. A significant between group difference was found for both ferritin ($p = 0.02$) and EGF ($p = 0.01$), with concentrations of ferritin decreasing in the MCT group and increasing in the RT group and concentration of EGF increasing in the MCT group yet decreasing in the RT group. The MCT program improved results of functional tests including chair stand and habitual walking speed.

Present findings suggest that although both the MCT and RT interventions were enough to produce functional and physical benefits, different training programs and/or exercise dose are required to improve metabolic health in healthy older adults.

1. Introduction

According to current projections, the proportion of the European population over 65 years will increase from 17% in 2010 to 30% in 2060 (Eurostat, 2011). Strategies that will contribute to a healthier, active and more independent elderly population are required to improve quality of life and reduce health care costs (Rice & Fineman, 2004). Regular physical activity can be regarded as an essential tool in providing health and quality of life among the elderly, as much evidence exists to support its role in improving functional mobility and reducing risk of disability (Denton & Spencer, 2010; Rice & Fineman, 2004). Examples of successful physical exercise strategies include RT which targets improvements in muscle mass and strength to combat sarcopenia and disability and more recently, MCT which may also include a RT component, but will combine it with additional exercise regimens including aerobic, balance, coordination and flexibility (Fulle et al., 2004). MCT which can combine several exercise forms including strength has been shown to be effective in preserving functional abilities and reducing risk for falls and fractures in older adults (Baker, Atlantis, & Fiatarone Singh, 2007). Recently, it has been highlighted the potential

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benefits of adding physical cognitive training as part of a training program to improve cognitive health among the elderly (Kraft, 2012).

While considerable evidence exists for the effect of such training regimens on physical and functional outcomes, data examining the effects of RT or MCT on markers of metabolic health are mixed (Bobeuf, Labonte, Khalil, & Dionne, 2010; Fahlman, Boardley, Lambert, & Flynn, 2002; Marques, Carvalho, Soares, Marques, & Mota, 2009; Ogawa, Sanada, Machida, Okutsu, & Suzuki, 2010). Prospective studies have shown abnormal levels of lipid profiles such as increased levels of total cholesterol and low levels of HDL-cholesterol are associated with a higher risk for cardiovascular conditions and mortality (Menotti et al., 2007; Okamura et al., 2006). Elevated levels of inflammatory markers such as CRP have also been related with an increased risk for type 2 diabetes and cardiovascular conditions having a potential role in initiating and exacerbating disease (Flynn, 2007). Furthermore, inflammation has been linked to the age-related loss in muscle mass and muscle strength which is considered a strong predictor of sarcopenia, functional decline and disability in the elderly (Peterson, Sen, & Gordon, 2011). Thus, maintaining metabolic risk factors at optimal levels may reduce risk for age-related conditions and mortality among the elderly.

Some studies, but not all, have found that RT was effective in improving biomarkers of metabolic health including blood lipids and inflammatory markers (Bautmans et al., 2005; Bobeuf et al., 2010; Fahlman et al., 2002; Onambele-Pearson, Breen, & Stewart, 2010). However, there are relatively few studies data examining the effects of MCT on metabolic health in the elderly, with some showing little or no change in metabolic health parameters (Beavers et al., 2010; Carvalho et al., 2009) and others reporting a significant improvement (Marques et al., 2009, 2013). Thus, the objective of the present study was to investigate and compare the effectiveness of 12 week RT and MCT programs on a diverse panel of biochemical markers including blood lipids, circulating glucose and inflammatory markers in a healthy elderly population.

2. Materials and methods

2.1. Subjects and experimental design

The study design is presented in Fig. 1. The study was approved by the Human Research Ethics Committee of University College Dublin. Sixty-one healthy, male and female subjects aged between 65 and 75 years were recruited to participate in the study by direct mailing, posters, brochures local active retirement groups and GPs offices. Eligible participants were chosen among community-dwelling individuals of both genders aged between 65 and 75 years. They were considered eligible if they had not taken part in any regular exercise for more than once weekly and met the criteria of "medically stable", as investigated through a medical history questionnaire (Greig et al., 1994) requiring not being on beta blockers and the absence of cardiac illness, history of cerebrovascular disease, severe lower limb arthritis, uncontrolled metabolic disease and other pathological conditions potentially influencing study outcomes. All the subjects were informed about the risks and benefits of the study before they signed a consent form. After informed written consent was obtained, participants were randomly assigned to either MCT or RT programs matching for gender and age. Once enrolled on the study, subjects were requested to attend three testing sessions.

The first session was one month prior to the start of training. This one month period acted as a control period during which subjects were requested to maintain their habitual physical activity level during this period. The second session took place at the start of the training program for baseline measurements and the final session following the 12 week training program. Each testing session took two days to complete. On day one, the subjects performed a battery of tests that measured anthropometry, body composition, functional ability, handgrip and aerobic fitness. On the second day resting heart rate and blood pressure were measured and a fasting blood sample was taken. For the purpose of this paper only the results from the second and third testing sessions were used in the analysis. All the subjects were asked to maintain their normal diet during the exercise intervention.

2.2. Exercise protocol

Following baseline measurements, subjects were assigned to undertake two weekly sessions of either RT or MCT for a period of 12 weeks, each lasting approximately 75–90 min. Classes were supervised by trained researchers to ensure safety and correct execution of the exercises.

The MCT classes aimed to improve neuromuscular and stimulate cognitive functions (Garber et al., 2011; Schaefer & Schumacher, 2011). The MCT classes were comprised of a 15-min

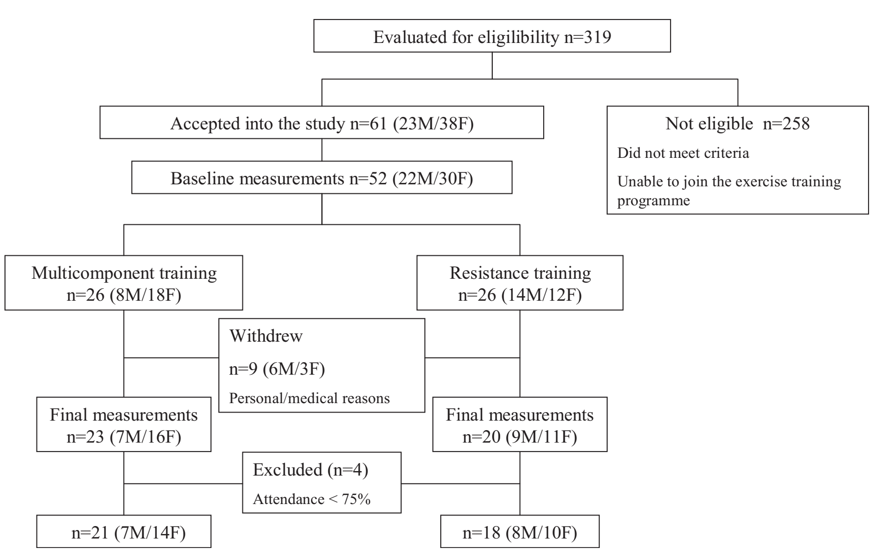

Fig. 1. Study design.