



QUASI-EXPERIMENTAL STUDY

# Effects of aerobic exercise on functional capacity, anthropometric measurements and inflammatory markers in diabetic elderly women



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## KEYWORDS

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**Summary** This study investigated the effects of an aerobic training program on functional capacity [Timed Up and Go test (TUG), timed 10-m walk test (10MWT), five-repetition sit-to-stand test (5-STs), handgrip strength test (HGS) and one-legged stance test (OLS)], anthropometric measurements [body mass, body mass index (BMI), waist and hip circumferences and waist-to-hip ratio] and plasma levels of inflammatory markers [soluble tumor necrosis factor receptors 1 and 2, and interleukins 6 and 10] in 43 elderly women with type 2 diabetes mellitus. After the training, a significant improvement was observed in the performance of the participants on the TUG, 10MWT, 5-STs and HGS and in the anthropometric measures of body

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mass, BMI and hip circumference. None of the inflammatory markers showed a significant difference between pre- and post-training. The aerobic exercise program improved the functional capacity of diabetic elderly women, but was ineffective to change the levels of the inflammatory markers evaluated.

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## Introduction

Type 2 diabetes mellitus (T2DM) is an important health condition in the elderly population. Approximately 20% of people aged 65 years or older have diabetes and this number may grow over the decades (American Diabetes Association, 2014). The chronic hyperglycemia of diabetes is associated with damage, dysfunction, and failure in several organs, including the retina, the kidneys, the nervous system, the heart, and the blood vessels, which may contribute to disability (Moreira et al., 2016). Furthermore, elderly with diabetes are at higher risk of premature mortality and to develop geriatric syndromes compared with older people without diabetes (American Diabetes Association, 2014; Araki and Ito, 2009).

Chronic subclinical inflammation that follows the aging process is an independent predictor of mortality and disability and is associated with obesity and T2DM (Wang and Nakayama, 2010; Lim et al., 2008). Previous studies have shown that pro-inflammatory cytokines such as interleukin-6 (IL-6) and tumor necrosis factor alpha (TNF- $\alpha$ ) are increased in individuals with T2DM (Muller et al., 2002; Fernandez-Real et al., 1998). Increased inflammatory markers contribute to the acceleration and progression of the diabetes and, the decline of functional capacity (Taaffe et al., 2000). Physical exercise programs for individuals with diabetes can reduce levels of inflammatory markers (Hopps et al., 2011), prevent functional disability (Araki and Ito, 2009) and improve gait speed (Allet et al., 2010). The literature reports that IL-6 derived from the muscular contraction promotes the release of other cytokines such as interleukin-10 (IL-10; anti-inflammatory) and inhibits production of TNF- $\alpha$  (pro-inflammatory) (Stewart et al., 2007; Drenth et al., 1995). In addition, IL-6 produced by muscle (myokine) has anti-inflammatory effects in contrast to IL-6 produced by the adipose tissue (Petersen and Pedersen, 2006).

The American Diabetes Association recommends that individuals with diabetes should exercise regularly for at least three times a week, prioritizing large muscle groups (American Diabetes Association, 2014). Among the benefits of exercise for individuals with T2DM are the improvement of the glycemic control, the reduction of the risk of cardiovascular events, weight loss and promotion of well-being (American Diabetes Association, 2014). In elderly patients with T2DM, the importance of regular exercise is even higher (Araki and Ito, 2009). However, the scientific evidence of these benefits for diabetic elderly population is still scarce.

Among the programs of physical exercise, aerobic training has traditionally been advocated as an essential component in the clinical management of T2DM (Lumb, 2014). The current consensus with respect to aerobic

exercise for older adults recommends that older individuals should accumulate at least 30 or up to 60 (for greater benefit) minutes/day in bouts of at least 10 min each. Reaching a total of 150–300 min/week of moderate-intensity activities or at least 20–30 min/day or more of vigorous-intensity activities to a total of 75–150 min/week or an equivalent combination of moderate and vigorous activity (Chodzko-Zajko et al., 2009). In diabetic patients, aerobic exercises can reduce metabolic risk factors, produce weight loss with significant improvement in insulin sensitivity and improve the physiological parameters, including glycemic control, fasting blood glucose level and lipid profile (Thent et al., 2013), in addition to decreasing the release of pro-inflammatory cytokines (Abd El-Kader et al., 2013). Additionally, aerobic training is dynamic and involves large muscle groups, improves physical performance and helps maintain the individual's functional independence (Araki and Ito, 2009). Therefore, it is essential to conduct studies that investigate the effects of aerobic training in elderly patients with T2DM.

Thus, the aim of this study was to assess the effects of an aerobic training program on functional capacity, anthropometric measurements and plasma concentrations of inflammatory markers in a sample of elderly women with T2DM living in the community.

## Methods

### Study design

A quasi-experimental study (pre-test, intervention and post-test) was conducted in a group of elderly women with T2DM. The design of the present study is illustrated in Fig. 1. This study was part of a randomized controlled trial (RCT) that was registered with the Brazilian Registry of Clinical Trials (ReBEC) under the number RBR9v9cwf. The RCT aimed to investigate the interaction between cytokine gene polymorphisms and the effect of physical exercise on clinical and inflammatory parameters in community-dwelling older women (Pereira et al., 2012). In the RCT, the participants were randomly assigned to muscle strengthening exercises or aerobic exercises. Data of the older women with T2DM, who were allocated to the aerobic exercise group, were analyzed in the present study. The research was approved by the Research Ethics Committee of the Universidade Federal de Minas Gerais (number ETIC 038/2010), and was conducted in accordance with the principles of the Helsinki Declaration and the Resolution number 196/96 of the National Health Council. Written informed consent was obtained from all participants before enrollment.

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