



## Original research

# Interdisciplinary therapy improves cardiorespiratory fitness and inflammatory markers in obese adult women



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## ABSTRACT

**Introduction:** Obesity is associated with an imbalance in cytokine concentrations, characterizing a low-grade chronic inflammatory status. The cardiorespiratory fitness is an important parameter that influences this inflammatory status, being a powerful predictor of early mortality. The interdisciplinary therapy has emerged as an alternative to prevent and treat obesity by improving health parameters. The aim of this study was to examine the effect of an interdisciplinary therapy on inflammatory markers and cardiorespiratory fitness in obese adult women.

**Methods:** A total of twenty-eight (n = 28) adult women (age 43.3 ± 5.5 years and BMI 34.9 ± 3.1 kg/m<sup>2</sup>) completed 20 weeks of interdisciplinary therapy involving physical exercise, nutritional and psychological support at Obesity Study Group in Federal University of São Paulo, Santos – Brazil. The cardiorespiratory fitness was measured through a maximal cycle-ergometer test. The inflammatory markers analyzed were leptin, TNF- $\alpha$ , MCP-1 and adiponectin.

**Results:** Improvement in leptin ( $\Delta$  -25.7% p < 0.001), MCP-1 ( $\Delta$  -12.6% p < 0.001), relative VO<sub>2</sub>Max ( $\Delta$  +15.4%, p = 0.001) and absolute VO<sub>2</sub>Max ( $\Delta$  +10.8%, p = 0.001) were observed after the interdisciplinary therapy. In addition, a relevant negative correlation (r = -0.45, p = 0.021) was found between leptin level and cardiorespiratory fitness.

**Conclusion:** The interdisciplinary therapy showed a significant positive effect on leptin and MCP-1 levels, cardiorespiratory fitness and metabolic profile. The therapy also showed an important negative correlation between leptin and cardiorespiratory fitness. These results suggest that the proposed methodology can be effective to treat obesity by increasing aerobic fitness and reducing proinflammatory pathways.

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## 1. Introduction

Obesity is a complex chronic disease in which genetic, hormonal, dietary, and environmental factors are involved. According

to the World Health Organization, the number of overweight people has increasing to an alarming rate. Approximately 39% of the total adult population are overweight, of which 600 million are obese (WHO, 2015).

In the past, obesity was considered a condition characterized by the deposition of inert fat. Recently, obesity is recognized as a chronic and systemic inflammatory disease, playing a crucial endocrine role on the production and secretion of numerous bioactive molecules, known as adipokines (Lehr et al., 2012; Marra and Bertolani, 2009).

*Abbreviations:* BMI, body mass index; CRF, cardiorespiratory fitness; MCP-1, monocyte chemoattractant protein-1; TNF- $\alpha$ , tumor necrosis factor – alpha; VO<sub>2</sub> Max, maximal oxygen uptake.

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On the one hand, proinflammatory adipokines like leptin, tumor necrosis factor – alpha (TNF- $\alpha$ ) and monocyte chemoattractant protein–1 (MCP-1), are involved in various obesity-related comorbidities, such as insulin resistance, diabetes, dyslipidemia, hypertension, hyperleptinemia and cardiovascular diseases (Yu and Ginsberg, 2005). On the other hand, anti-inflammatory adipokines like adiponectin has protective and beneficial function to our body. Adiponectin can decrease the macrophages chemotaxis and monocyte adhesion to the tissues (Allende-Vigo, 2012), besides it has anti-atherogenic and anti-diabetic functions (Lu et al., 2012; Dandona et al., 2005). It is known that high concentration level of proinflammatory cytokines and low level of adiponectin are closely associated with visceral adiposity, insulin resistance, metabolic syndrome and systemic inflammation (de Piano et al., 2010). Consequently, this scenario leads to an increased risk of cardiovascular disease.

The cardiorespiratory fitness (CRF) is another important parameter that influences the inflammatory status (Després, 2014), being a powerful predictor of early mortality (Myers et al., 2002). The gold standard to determine CRF is maximal oxygen uptake (VO<sub>2</sub>Max), measured by a maximal exercise testing. Previous studies provides evidence that low VO<sub>2</sub>Max is related to a pro-inflammatory condition (Kullo et al., 2007), however, which inflammatory markers are associated with this process remains unclear.

Studies showed that some changes in eating, behavioral habits and improvement of CRF can result a decrease on body mass and on proinflammatory markers in obese population (Damaso, 2009). In this sense, a multifocal treatment to improve fitness, eating and behavioral habits could provide an improvement in health and quality of life. However, these results are still controversial. While some recent studies have demonstrated that physical exercise and weight loss by calorie restriction can reduce inflammatory condition (Miranda et al., 2011; Christiansen et al., 2010), Sartipy et al. showed that even a reduction in weight was not enough to improve the inflammatory profile of obese adults (Sartipy and Loskutoff, 2003).

Even though some studies have investigated the effects of a standalone nutritional or exercise program on obesity, only a few have described the effects of a combined program. In view of this, the aim of the present study was to evaluate the effects of an interdisciplinary therapy on inflammatory markers and cardiorespiratory fitness of obese adult women.

## 2. Materials and methods

### 2.1. Participants

Obese adult women were invited by through media such as TV, radio and newspaper to participate in the Interdisciplinary Therapy – Obesity Study Group (GEO), at the Federal University of São Paulo – Santos – Brazil.

A total of 47 obese adult women were enrolled in the program. However, only 28 patients completed 20 weeks of therapy and concluded all steps during this study. The inclusion criteria was: a) body mass index (BMI) between 30 and 39,9 kg/m<sup>2</sup>; b) age between 30 and 50 years. Exclusion criteria were: a) musculo-skeletal limitations that affect the practice of physical exercise; b) bariatric surgery; c) excessive chronic alcohol consumption; d) pregnancy.

This study was performed in accordance to the principles of the Declaration of Helsinki and was formally approved by the Institutional Ethical Committee (#0085-11) by Federal University of São Paulo (UNIFESP). All volunteers signed a free and informed consent.

### 2.2. Design study

The research design in the interdisciplinary therapy period was 20 weeks composed by nutritional therapy, psychological therapy, and exercise program (Fig. 1). The propose of the interdisciplinary therapy was recognized by the World Health Organization (WHO, 2000) and in agreement with our previous studies published by our group in corroborate with Dâmaso e cols (Dâmaso et al., 2013).

#### 2.2.1. Nutritional therapy

Food consumption was set at the recommended level of dietary intake for individuals with low physical activity level, based on age, gender, and a balanced diet (Murphy and Poos, 2002). No medication or types of supplements were recommended. Once a week, individuals received nutritional guidance in groups that discussed important issues involved in changing lifestyle habits. Among other topics, information was provided such as the food pyramid, weight loss and fad diets, food labels, fat-free and low-calorie food, dietary substitutes, good nutritional choices, and functional foods. Practical experimental cooking classes were conducted to improve the participants understanding of portion sizes, healthy recipes, etc. To assist participants in weight loss, each volunteer received a food plan with 500 calories deficit from their energy requirements, considering nutritional guidelines to associated comorbidities.

#### 2.2.2. Psychological therapy

Obese adults were invited to attend once a week psychological group sessions to discuss common psychological problems associated with obesity. For example, depression, anxiety, body image dissatisfaction, eating disorders, such as binge eating, bulimia, and anorexia nervosa, the relationship between food and feelings, stress, family problems, among other topics. The relation between the signals, symptoms and consequences for health with the causes and maintenance of obesity was also discussed. Interventions were focused on developing coping strategies, relaxation techniques, body awareness, self-knowledge and behavioral changes.

#### 2.2.3. Exercise program

The volunteers were submitted an exercise training with moderate intensity according our program: (60 min/session) who included 30 min of aerobic training plus 30 min of resistance training per session. In this way, prioritizing the improvement of coordination, balance, motor control, aerobic and muscular endurance three times a week (180 min/week), under the supervision of a sports physiologist, with an intensity between 13 and 16 points on the Borg's Scale (Borg 1982). Moreover, spontaneous physical activity were also encouraged, e.g., walking, climbing stairs, dancing, as a way of changing their lifestyle. The exercise program was based on guidelines from the American College of Sports Medicine (Donnelly et al., 2009).

#### 2.2.4. Interdisciplinary care

Weekly meetings were held by the research group in order to discuss major difficulties faced by study participants and try to implement major strategies to overcome or minimize them. Moreover, once a month interdisciplinary interventions were planned and carried out by professionals from different areas, enabling integration across disciplines and to promote a better integration of this study.

### 2.3. Evaluation

All the evaluations were performed before and after the interdisciplinary therapy.

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