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Research report

Aerobic training (AT) is more effective than aerobic plus resistance training (AT + RT) to improve anorexigenic/orexigenic factors in obese adolescents ☆

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ABSTRACT

Background: The regulation of energy balance is influenced by physical exercise. Although some studies show a stimulation of hormones related to food intake, others show that exercise provides satiety. *Aim:* The aim of this study was to compare the effects of aerobic training (AT) and aerobic plus resistance training (AT + RT) on anorexigenic and orexigenic factors in obese adolescents undergoing interdisciplinary weight loss therapy. *Methods:* A total of 26 obese adolescents, aged 15–19 years with BMI ⩾ P95 were submitted to 12 months of interdisciplinary intervention (clinical support, nutrition, psychology and physical exercise) and divided into two groups, aerobic training (AT) ($n = 13$) or aerobic plus resistance training (AT + RT) ($n = 13$), which were matched according to gender and body mass. Blood samples were collected to analyze orexigenic factors (AgRP, NPY, MCH) and the anorexigenic factor alpha-MSH. *Results:* The AT and AT + RT groups significantly reduced body mass, body mass index and body fat mass (kg) during the therapy. The AT group showed no significant changes in body lean mass (kg), whereas the AT + RT group showed an increase in body lean mass (kg) during the interdisciplinary intervention. There was an increase in AgRP levels (ng/ml) only in the AT + RT group after 6 months of interdisciplinary intervention compared with baseline condition. Conversely, α-MSH levels (ng/ml) increased only in the AT group after 12 months of interdisciplinary intervention compared with baseline condition. *Conclusion:* Aerobic training (AT) as part of an interdisciplinary therapy is more effective than aerobic plus resistance training (AT + RT) to improve secretion of anorexigenic/orexigenic factors in obese adolescents.

Introduction

An interdisciplinary intervention, incorporating both psychological and physiological components, is important to promote the reduction of body mass, blood pressure and coronary diseases (Carnier et al., 2010; Sanches et al., 2012). Thus, physical exercise has an important role in helping with weight loss, as well as maintaining increased energy expenditure (Foschini et al., 2010; Luís Griera et al., 2007). However, a deeper understanding of the connections between physical activity and appetite is needed to optimize treatment of patients with obesity.

There are many factors involved in hunger and satiety signals. Leptin, a key point of this regulation, is secreted by adipose tissue and transported to the brain, where it crosses the blood-brain barrier and binds to its specific receptor (OB-R) in two neuronal populations in the arcuate nucleus (ARC) in the hypothalamus. The neurons pro-opiomelanocortin (POMC), and cocaine- and amphetamine-regulated transcript (CART) stimulate the expression of α-melanocyte-stimulating hormone (α-MSH) – secreting neurons and inhibit the expression of neuropeptide Y/agouti-related protein (NPY/AgRP) (Boguszewski, Paz-Filho, & Velloso, 2010; Diéguez, Vazquez, Romero, López, & Nogueiras, 2011).

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These primary targets of leptin signaling communicate with second-order neurons in other hypothalamic nuclei, especially in the paraventricular nucleus and lateral hypothalamus, to stimulate the expression of anorexigenic neurotransmitters, including corticotropin-releasing hormone (CRH) and thyrotropin-releasing hormone (TRH), and to inhibit orexigenic pathways, including orexin and melanin-concentrating hormone (MCH). The final biological actions of leptin are inhibition of food intake and stimulation of energy expenditure (Boguszewski et al., 2010; Diéguez et al., 2011).

This complex system of regulation of energy balance is influenced by physical exercise. Although some studies show a stimulation of hormones related to food intake, others show that exercise provides satiety (Cook & Schoeller, 2011). Understanding the energy balance effects of different types of physical exercise could help with the treatment of obese patients.

Aerobic training (AT) and aerobic plus resistance training (AT + RT) are the exercise training programs most studied for the treatment of obesity. The relationship between the type of exercise performed and food intake is not very clear in the literature. Thus, the aim of this study was to compare the effects of both programs as part of an interdisciplinary therapy as measured by AgRP, NPY, MCH and α-MSH levels in obese adolescents. We hypothesized that there would be no differences in the energy balance regulation between both types of exercise.

Methods

Study population

A total of 134 adolescents were selected to participate of the present study. They were selected from GEO (Interdisciplinary Obesity Program) of Universidade Federal de São Paulo – UNIFESP in 2010.

Of these 134 participants, we excluded 74 (36 from the AT group and 38 from the AT + RT group) because they did not complete the therapy for reasons such as starting a professional job, changes in school schedule, lack of motivation and lack of money for transportation. Additionally, participants who did not perform all necessary examinations in the three stages of evaluation and who did not complete 75% of all therapies were also excluded. Forty-seven of the remaining 60 obese adolescents were initially included in the AT + RT group and 13 were in the AT group. To evaluate the same number of volunteers in each group, the 13 patients of the AT group were matched according to gender and body mass with volunteers from the AT + RT group. Thus, a total of 26 obese adolescents were evaluated in this study (13 adolescents performed the AT exercises and 13 adolescents performed the AT + RT exercises). There were five boys and eight girls in each group (AT and AT + RT group) (Fig. 1).

The inclusion criteria for participating in this program for weight loss were as follows: post-pubertal adolescents presenting with obesity who were healthy enough to perform physical activity and available to participate in the program for 1 year. All adolescents were aged from 15 to 19 years, presented with obesity (BMI > 95th percentile, according to the Center for Disease Control and Prevention) and were considered post-pubertal (Tanner Stage = 5). An endocrinologist assessed the Tanner stage, appointing the value that best identified the stage of sexual maturation for each adolescent (Tanner & Whithouse, 1976). All adolescents completed the effort electrocardiogram maximum test until exhaustion to verify whether they could safely perform physical exercise. The non-inclusion criteria were limitations such as an identified genetic disease (e.g. Down syndrome), metabolic or endocrine diseases, chronic alcohol consumption or previous use of drugs such as glucocorticoids and psychotropics or pregnancy (Fig. 2).

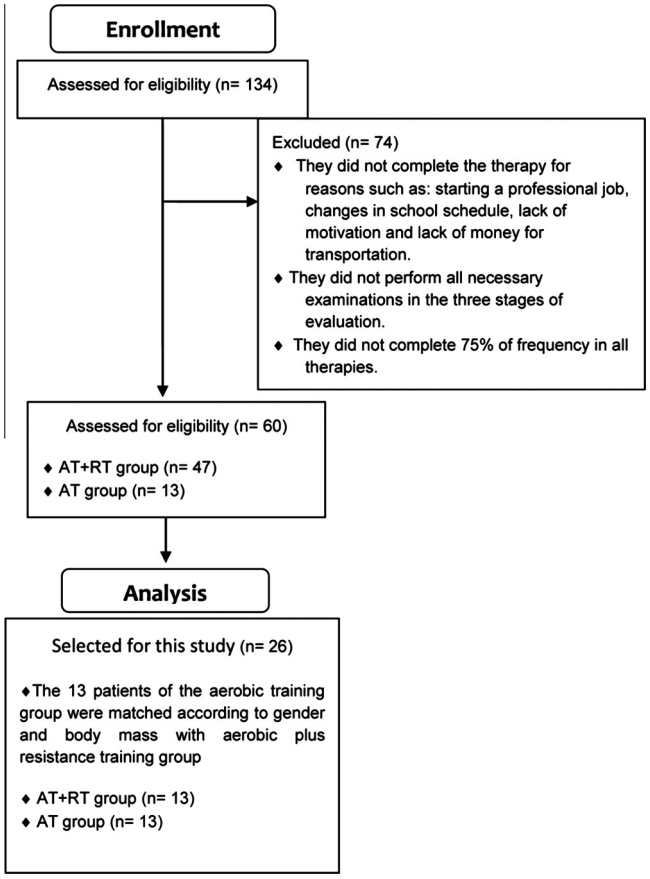

Fig. 1. Selection of volunteers for the study.

This study was performed in accordance with the principles of the declaration of Helsinki and was formally approved by the Ethical Committee of the Universidade Federal de São Paulo – UNIFESP (#0135/04). Informed consent was obtained from all subjects and/or their parents. This study was registered at clinicaltrials.gov (NCT01358773).

Research design

The volunteers were submitted to 1 year of interdisciplinary intervention (clinical support, nutrition, psychology and physical exercise) and divided into two groups, aerobic training (AT) or aerobic plus resistance training (AT + RT) (Fig. 2). These aspects of therapy will be described further below. During the first month, the adolescents were submitted for evaluations. Thereafter, they started the interdisciplinary weight loss program. The same evaluation procedures were performed after short – (6 months) and long-term (12 months) therapy (Dâmaso, de Piano, Tock, & Srirajaskanthan, 2009). All interventions and evaluations were conducted in the CEPE (Centro de Estudos em Psicobiologia e Exercício) from AFIP, where some research studies of the *Universidade Federal de São Paulo* are conducted.

Measurements

Subjects were weighed to the nearest 0.1 kg on the Filizola scale while wearing light weight clothing and no shoes. Height was measured to the nearest 0.5 cm using a wall-mounted stadiometer (Sanny, model ES 2030). Body mass index (BMI) was calculated as the body weight (wt) divided by height (ht) squared (wt/ht^2). Body composition was measured by air-displacement in a BOD