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Plasma levels of leptin in overweight adults undergoing concurrent training

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Abstract

Objective: To assess the acute effects of concurrent training (CT) on plasma leptin levels in overweight adults. **Material and methods:** Quasi-experimental research methods were used. A sample of twenty individuals (27.7 ± 5.1 years-old, BMI 27.08 ± 1.42) was randomly divided between the experimental group (EG: n=10) and the control group (CG: n=10). After subjects had fasted for 12 hours, blood samples were collected from both groups, and plasma leptin levels were assessed. Forty minutes after breakfast, the EG performed CT which included an indoor cycling class (40min, OMNI 5-7) followed by resistance training (3 series performed until exhaustion in the supported row machine, leg press, straight bench press, knee extensor, elbow flexor, knee flexor and elbow extensor, 85% 1RM, 2-3min interval). The CG did not perform the physical exercises. At the end of the CT, blood samples were collected from the EG. Descriptive statistics were used and for the inferential analysis a two-way ANOVA was undertaken. The Shapiro-Wilk test was used to check homogeneity and Tukey's Post-Hoc test was used for normality analysis. The significance level adopted was $p < 0.05$. **Results:** The EG ($\Delta\% = 2.92$; $p = 0.01$; 15.05 ± 3.32 ng/mL for 12.13 ± 3.01 ng/mL) and CG ($\Delta\% = 5.32$; $p = 0.00$; 26.04 ± 9.13 ng/mL for 20.72 ± 8.51 ng/mL) had significant reductions in plasma leptin levels. **Conclusion:** In its acute phase, CT causes a reduction in the plasma leptin levels of overweight individuals. **Keywords:** leptin, physical exercise, resistance training, aerobic training, hormones



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Introduction

Overweight and obesity are defined as abnormal body fat accumulations that can be harmful to human health¹. The prevalence of these conditions has increased in the last few decades in developed and developing countries² and for that reason, it has been declared a global epidemic³. However, adipose tissue has been observed to be more than a simple fat storage medium; it also acts as an endocrine organ⁴ capable of producing several substances, among them leptin^{5,6}.

Leptin is a hormone especially produced by the white adipose tissue⁷⁻⁹ which has been widely

studied in recent years⁶. Studies¹⁰⁻¹² suggest that leptin plays a central role in food intake regulation and energy balance in mice. In humans, it is known as a body weight regulator due to its hypothalamic function^{5,13}. Acting through receptors, leptin modifies the expression and activity of several hypothalamic peptides that regulate food intake and energy expenditure⁸, and therefore helps in the weight loss process.

Concurrent training has been studied in the search for new methods to reduce rates of overweight and obesity. This term is used to characterise the method whereby aerobic and strength training exercises are performed in



the same training session¹⁴⁻¹⁷. That strategy was chosen because energy expenditure could be maximised both during and after the training through increased oxygen consumption after exercise¹⁸.

Some authors mention concurrent training in their publications^{14-16, 19, 20}. However, thus far none of them have investigated the acute or chronic effects of this type of training on plasma leptin concentrations. Therefore this study aims to analyse the acute effects of concurrent training on plasma leptin levels in overweight adults.

Methods

A quasi-experimental research model was used²¹ in this study.

Sample

The sample consisted of twenty individuals (average age 27.7 ± 5.1 years, BMI 27.08 ± 1.42) of both genders who had practiced regular exercise for at least six months at least three days per week and who did not have any apparent risk factors that could prevent their participation in the study in agreement with the American Heart Association Risk Stratification Criteria²². They were randomly divided into an experimental group (EG: $n=10$) and a control group (CG: $n=10$) according to the simple randomisation model.

Research participants signed an Informed Consent document in accordance with the Helsinki Declaration²³. The research project for the study was submitted to the Human Subjects Research Ethics Committee at Castelo Branco University, under protocol no. 0189/2008.

Data collection

Initially study participants completed the Physical Activity Readiness Questionnaire (PAR-Q) and a dietary recall document. Subsequently they underwent an anthropometric evaluation, including measurements of body mass, height, body mass index (BMI) and body composition by means of the Jackson seven skin-fold protocol, Pollock (1978)²⁴.

To evaluate body mass and height, a 150kg capacity scale with 100g accuracy was used in combination with a Filizola (Brazil) stadiometer. For the skinfold measurement, a CESCORF (Brazil) calliper with 0.1mm accuracy was used. The aforementioned evaluations used the procedures recommended by the International Society for the Advancement of Kinanthropometry²⁵.

On the second day, the One Repetition Maximum (1RM) test was performed in accordance with the guidelines described by Baechle; Earle²⁶, aimed at the prescription and control of the intensity of the following exercises: supported rowing, 45° leg press, straight bench press, knee extensor, elbow extensor (HBM), knee flexor and elbow flexor (high-pulley). To measure the maximum oxygen consumption (VO_{2max}) the Balke (1980) protocol was used for the cycloergometer²⁴, in order to prescribe and control indoor cycling intensity. The last procedure was performed on the third day of data collection.

Interventions

Blood samples were collected from both groups in order to check the baseline leptin levels and were followed by a twelve-hour fast.

The individuals had a normal breakfast consisting of 200ml fat-free yogurt, two slices of light wholewheat bread, 30g of fresh cheese, 10g of margarine and one medium-sized banana. Forty minutes later, the EG performed one concurrent training session comprised of an approximately 40-minute continuous indoor cycling class with intensity ranging from 5 to 7 on the OMNI scale of perceived exertion for cycling²⁷, followed by a resistance training session consisting of three series performed until exhaustion for each exercise tested. The intensity was 85% 1RM for all of the exercises and the interval between sessions was 2-3 minutes. The protocols are presented in Tables 1 and 2. The CG did not perform any type of physical exercise. After these procedures, blood was collected from both groups to re-assess their plasma leptin levels.



Table 1: Indoor cycling protocol

Time (min)	Phase	Intensity (OMNI)
1-5	Warm up	2-4
5-35	Continuous training	5-7
35-40	Slow down	0-2

Table 2: Resistance training protocol

Exercise	Sets	Repetition	Intensity	Interval
Supported Row	3	Until exhaustion	85% 1RM	2'-3'
Leg Press 45°	3	Until exhaustion	85% 1RM	2'-3'
Standing Bench Press	3	Until exhaustion	85% 1RM	2'-3'
Knee Extensor	3	Until exhaustion	85% 1RM	2'-3'
Elbow Flexor	3	Until exhaustion	85% 1RM	2'-3'
Knee Flexor	3	Until exhaustion	85% 1RM	2'-3'
Elbow Extensor (high-pulley)	3	Until exhaustion	85% 1RM	2'-3'

The blood samples were collected at the study site by qualified staff from the “Sérgio Franco Medicina Diagnóstica” laboratory, Brazil, and transported to the laboratory for radioimmunoassay analysis to measure the plasma leptin levels.

All of the statistical procedures were processed with the *Statistical Package for the Social Sciences* software (SPSS 10.0, Chicago, USA). Descriptive statistics were used to establish the median and standard deviation values. A two-way ANOVA test was used for

inferential analyses. The Shapiro-Wilk (SW) test was used to check sample homogeneity and Tukey's Post-Hoc test was used for normality analysis. A significance level of $p < 0.05$ was applied.

Results

Table 3 presents data of age, weight, height and BMI of the participants from EG and CG groups. All participants in the study were classified as overweight (25 to 29.9 BMI) by the World Health Organization criteria ¹.



Table 3: Feature values (mean±DP) and group homogeneity

	Age (years)	Weight (kg)	Height (m)	BMI
GI (n=10)	27,9 ± 4,9	76,9 ± 17,9	1,67 ± 0,14	26,8 ± 1,5
SW (p-value)	0,84	0,13	0,57	0,79
CG (n=10)	27,5 ± 5,4	80,1 ± 14,6	1,70 ± 0,12	27,3 ± 1,3
SW (p-value)	0,47	0,39	0,51	0,27

There was a reduction ($\Delta\%=2.92$) in the basic leptin results in the EG, while in the CG the reduction was larger ($\Delta\%=5.32$), as presented in Table 4. In both groups, the reduction in

leptin levels was statistically significant ($p<0.05$) when comparing pre- and post-intervention.

Table 4: Plasma leptin levels in groups before (pre) and after (post) intervention

Leptin (ng/mL)	Experimental Group (n=10)	Control Group (n=10)
Pre (mean ± DP)	15,05 ± 3,50**	26,04 ± 9,62**
Post (mean ± DP)	12,13 ± 3,17# **	20,72 ± 8,97# **
$\Delta\%$	-2,92	-5,32
p-value	0,01	0,00

#Significant difference ($p<0, 05$) intra group, ** Significant difference ($p<0, 05$) inter group

Discussion

All participants in the study were classified as overweight ¹. According to Negrão ⁸ and Mota ⁶, the bloodstream leptin levels are linked to the amount of adipose tissue on any individual. The overweight condition of the study participants did not change after the intervention because no acute alteration in their BMIs was detected. However, the plasma leptin levels decreased significantly.

In contrast to the present study, Pérusse ⁷ did not identify any effects of acute or chronic exercise on plasma leptin levels independently of alteration in the fat mass.

According to Hulver ²⁸, research that examined only one exercise session suggests that leptin concentrations are not altered by non-

exhaustive exercise lasting 41 minutes or less, but can be affected by exhaustive exercise of the same duration. The research also states that studies investigating exercise sessions with a duration equal to or greater than one hour, as is the case in the present study, are more efficient with regard to a reduction in plasma leptin concentrations.

Licinio ²⁹ and Sinha ³⁰ found that plasma leptin levels are pulsatile, with approximately 30 pulses in a 24-hour period. According to Sinha ³⁰, the concentrations reach peak levels between 11h00 and 13h00. Sample collections in the present investigation occurred before 11h00, and are therefore outside of the time period mentioned in Sinha's research ³⁰. The reduction in plasma leptin levels is directly related to fasting ⁶ and weight loss ³¹. In the present study, the participants did not present



with weight loss, but there was a reduction in leptin levels. This indicates that perhaps there are other mechanisms regulating the plasma levels of this variable.

According to Fried³¹, insulin and cortisol play an important role in leptin production. However, Hafner¹¹ pointed out that leptin concentrations are not related to cortisol. Nevertheless, Licinio³² asserts that this conclusion is erroneous and reflects an insufficient sample because in other studies^{29, 33} an inverse correlation between these two hormones was found.

In recent years, several studies were performed with the goal of verifying the relationship between plasma leptin levels and physical exercise. These studies evaluated the acute and chronic effects of aerobic exercise and strength training on leptin levels in several populations and presented conflicting data regarding the behaviour of this variable⁶. However, there are few studies in the literature on the subject of the impact of concurrent training on leptin levels. This present study's data reveals that exercise sessions induced an acute reduction in plasma leptin levels, corroborating with the findings of Kanaley³⁴, Landt³⁵, Keller³⁶ and Jürimäe³⁷. Yet none of these studies analysed the feedback from the concurrent training; rather they examined aerobic or strength training performed in an isolated manner.

In conclusion, a concurrent training session as performed in the present study induces a reduction in plasma leptin levels. However, further research is recommended to examine the chronic effects of the same training with control of other blood variables, such as insulin and cortisol.

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