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ORIGINAL ARTICLE

Investigation of serum leptin levels in professional male football players and healthy sedentary males

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Abstract

OBJECTIVE: In the present study we aimed at investigating leptin levels in professional male athletes who have been exercising regularly for a long time and leptin levels in healthy sedentary males.
METHODS: The study included 10 male professional football players and 17 healthy sedentary males. The relations between groups in terms of leptin levels, Max VO_2 levels, blood lactic acid levels before and after exercise and effort durations were investigated.
RESULTS: It was found in the study that although BMI of professional male athletes was higher than that of the healthy sedentary males, leptin levels of the former were significantly lower ($p<0.01$), while VO_2Max levels ($p<0.05$) and test periods ($p<0.01$) were significantly higher than those in the latter. As for lactic acid levels after exercise and between groups, these were also higher in athletes, but the difference was not statistically significant ($p>0.05$).
CONCLUSION: Leptin levels of those who exercised regularly were found lower than the levels in healthy males. Although the increase in serum leptin levels is in direct proportion with BMI in general, the major determinant of serum leptin level is the body fat rate. As regular exercising reduces body fat rate, it also reduces serum leptin levels.

Introduction

Leptin is a member of the cytokine family. It is a protein made up of 167 amino acids. Although it is mainly secreted from the white adipose tissue, it is also secreted in very small amounts from the brown adipose tissue. It is found in the circulation bound mainly to soluble leptin receptors [1]. It interacts with many systems from the gastrointestinal system to the hemopoietic system, from hypertension to obesity control [2]. Leptin is necessary for regulation of neuroendocrine functions and energy consumption. As a hormone, it also plays an important role in the development of the fetus, commencement and development of puberty in children and in blood production [3–5].

Its biological effects are suppressing food intake and increasing energy consumption. Owing to these effects, the leptin hormone is important in weight control of the body. It influences the satiation center in the ventro-medial hypothalamus [6,7]. Rodents which were genetically obese or had induced obesity were seen to have a reduction in body weight and an improvement in metabolic control after leptin injection.

The leptin hormone has an inhibitory effect on the activity of acetyl co-A carboxylase, which is an enzyme that decelerates fatty acid synthesis. Thus, leptin decreases fatty acid and triglyceride synthesis, increases lipid oxidation and reduces fat storage [7].

Although the effects of leptin hormone on the skeletal muscle lipid metabolism are known, its effects on glucose metabolism have not been clarified yet. Exercise, on the other hand, is known to increase both free fatty acid and glucose metabolism.

Leptin is a hormone that is directly related with body fat rate and BMI. It is important in food intake and in controlling body fat weight. Aerobic exercises increase use of free fatty acids, decreasing at the same time fat tissue of the body. In the present study, we aimed at investigating the effects of chronic exercises on serum leptin levels by comparing leptin levels of professional male football players who have been making regular aerobic exercise for a long time and healthy sedentary males, in consideration of the effects of leptin and exercise on fat metabolism.

Materials and Methods

The study included 10 male professional football players and 17 healthy sedentary males. The male professional football players have mean age 18.30 (1.06) years, mean weight 70.60 (5.73) kg, mean height 175.00 (7.86) cm, body fat rate 7% (1.2) and BMI 23.03 (1.16) kg/m^2, while healthy sedentary males have mean age 21.71 (2.23) years, mean weight 65.76 (6.82) kg, mean height 175.58 (6.07) cm, body fat rate 12% (2.4) and BMI 21.39 (2.54) kg/m^2. The study was carried out in Laboratories of Istanbul University, Istanbul Faculty of Medicine, Sport Medicine Department and Selcuk University, Meram Faculty of Medicine, Central Biochemistry Laboratory.

Professional football players who participated in the study have been regularly exercising for at least five years (their schedule includes aerobic-focused dynamic exercise 5 days a week, 1.5 hours a day, a match a week and one day rest a week throughout the football season). Healthy sedentary males who were included in the study as the control group were not engaged in any sports activity except for their daily routine activities.

Individuals in both groups were made to have a mild breakfast at 8 o'clock in the morning. In order to find out serum leptin levels, 5 ml of blood were taken from forearm veins at about 9.30 in the morning. Serum leptin levels were identified in the serum obtained from the venous blood collected; the RIA method was used.

VO_2Max levels were determined with a SensorMedics 2900-C metabolic test system during maximal exercise test conducted in accordance with the Bruce protocol using the breath-by-breath method.

Body fat percentages were calculated using the Jackson and Baumgartner [8] method by measuring skin thickness at seven different regions of the body (triceps, axillar, subscapular, pectoral, abdominal, suprailiac and thigh regions) by skin-fold clipper.

Lactic acid levels were determined using Pro-lactate kit in the blood taken from the fingertip in the 1st minute before and after exercise.

The relations between groups in terms of leptin levels, Max VO_2 levels, blood lactic acid levels before and after exercise and effort durations were investigated.

Statistical analyses were conducted using the Independent Sample-t Test in SPSS-10 program. Data were presented as arithmetic mean ± standard deviation and the level of significance is set at $p<0.05$.

Results

Anthropometric measurement values of both groups, as seen in Table I, show that mean age of healthy males was 21.71±2.23 years, mean height was 175.58±6.1 cm, mean weight was 65.76±6.82 kg, mean BMI 21.39±2.54 kg/m^2 and body fat rate 12±2.4%. As for professional football players, their anthropometric measurement values demonstrate that their mean age was 18.30±1.06 years, mean height was 175.0±4.83 cm, mean body weight was 70.60±5.74, mean BMI 23.03±1.26 kg/m^2 and mean body fat rate 7±1.2%. While there was no statistically significant difference between mean heights

Table I: Anthropometric measurements

	Age (years)	Height (cm)	Weight (kg)	BMI (kg/m^2)	Body fat rate (%)
Sedentary males (n:17)	21.71±2.23	175.58±6.1	65.76±6.82	21.39±2.54	12±2.4
Football players (n:10)	18.30±1.06	175.0±4.83	70.60±5.74	23.03±1.16	7±1.2
P value	P<0.05	p>0.05	P<0.05	P<0.05	P<0.05

Table II: Maximal exercise test and serum leptin results of professional male football players and healthy sedentary males

	Sedentary males (n:17)	Football players (n:10)	P value
Leptin (ng/ml)	6.32±3.95	2.56±1.93	=0.003
VO_2 Max (ml/kg/min.)	51.45±4.40	63.74±5.54	<0.001
Test period (minute)	10.63±0.74	14.02±0.64	<0.001
Lactic acid before exercise (mmol/lt)	1.66±0.44	1.75±0.07	>0.05
Lactic acid after exercise (mmol/lt)	7.96±3.26	10.45±0.21	<0.05

of the groups, significant differences were found in terms of age, body weight, BMI and body fat percentage ($p<0.05$).

Serum leptin levels, maximal oxygen uptake, exercise duration and lactic acid values that are presented in Table II demonstrate that levels of serum leptin hormone were higher in healthy males (6.32±3.95 ng/ml) than in football players (2.56±1.93 ng/ml) ($p=0.003$) (Figure 1). When levels of maximal oxygen used by subjects during exercise are investigated, it is seen that VO2Max values in healthy males (51.45±4.40 ml/kg/min) were significantly lower than those in football players (63.74±5.54 ml/kg/min) ($p<0.001$). As for periods of time for which both groups could continue maximal exercise, the periods were longer in football players than in healthy males ($p<0.001$) (test period is 14.02±0.64 minutes for football players and 10.63±0.74 minutes for healthy males). There was no difference between groups regarding lactic acid levels before exercise (1.66±0.44 mmol/lt for healthy males and 1.75±0.07 mmol/lt for football players), whereas lactic acid levels after maximal exercise were higher in football players (7.96±3.26 mmol/lt in healthy males and 10.45±0.21 in football players) ($p<0.05$).

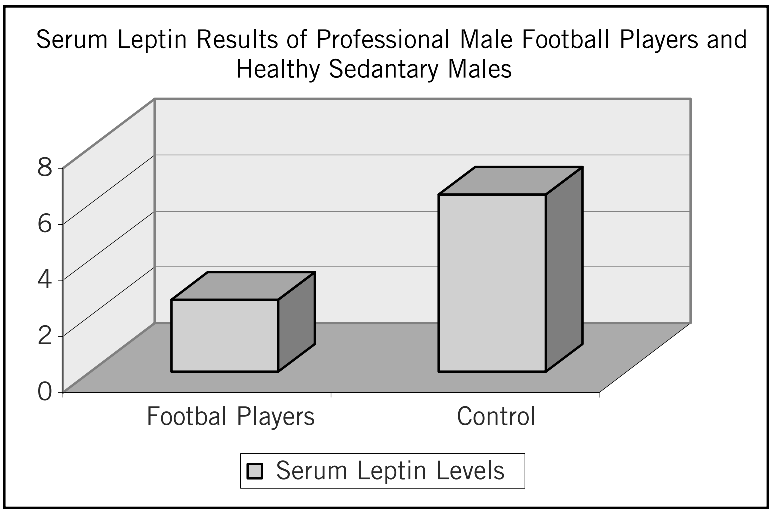

Figure 1: Serum leptin results of professional male football players and healthy sedentary males

Discussion

The hormone leptin has been a widely researched topic due to its being directly involved in food intake and energy consumption [9–11]. While its possible use in morbid obese and obese people for the purpose of weight control was being discussed, its efficiency in controlling body fat weight was brought to the agenda. Since less body fat weight brings about more use of VO_2 Max, leptin is expected to enhance performance in physical endurance sports. There is a negative correlation between body fat weight and VO_2 Max [12].

In our study, although male professional football players did have higher BMI than healthy sedentary males, leptin levels were significantly lower in the former ($p<0.01$). Despite higher BMI, serum leptin levels are lower in football players is that body fat rate in football players is lower than that in healthy males. VO_2Max values were also found significantly higher and test periods longer in the group comprising athletes ($p<0.001$). This finding showed that regular exercise increases the amount of usable oxygen and reduces body fat rates. The fact that exercise period was longer in football players also supports this finding. Lactic acid levels after exercise were found to be higher in football players due to their longer exercise periods ($p<0.05$) (Table 1, Figure 1).

The relation between leptin and exercise has attracted the attention of a number of researchers. Hickey et al. [13] reported that in male long distance runners leptin levels did not change after the run. Kraemer et al. [14] reported that leptin levels in menopausal women who were not using hormone replacement did not change after acute exercise.

Torjman et al. [15] did not find a change in serum leptin levels neither after short-term maximal exercise nor after 4 hours following long-term aerobic exercise at 50% of VO_2Max, whereas Leal-Cerro et al. [16] demonstrated that serum leptin levels decreased immediately after marathon.

The reason why different studies obtain different results is concerned with the intensity of exercise. The intensity of the exercise is important in the change in serum leptin level. Leal-Cerro et. al. [16] reported that there was a decrease in serum leptin levels after a marathon where athletes spent 2800 kcal energy. Essing et al. [17] stated that in order for exercise to affect serum leptin level, an energy consumption of 800–1500 kcal was needed. They reported that a decrease in serum leptin level was observed 24 hours after an exercise where 800–1500 kcal energy was consumed. The athletes in our study spent about 1200–1300 kcal per exercise.

Duration of exercise and the time when blood is taken after exercise are as important as the intensity of exercise in determining serum leptin level. Touminen et al. [18] showed that following a 2-hour treadmill run there was a 34% reduction in serum leptin level after 24 hours. Weltman et al. [19] stated that serum leptin level did not change 3.5 hours after a 30-minute aerobic exercise. Essing et al. [17] found a 30% decrease in serum leptin level 48 hours after aerobic exercise made at 70% of VO_2Max. In a study including 10 healthy males, Nindl et al. [20] could not establish any significant change in plasma leptin levels until 9 hours after acute resistive exercise, but found a decrease after 9 hours (26% decrease in the 9^{th} hour, 33% in the 13^{th} hour). Athletes in our study have had 5 exercises per week (football exercise for 1.5 hours a day), one match and one day rest. Kraemer et al. [21] reported that serum leptin levels did not change after short-term acute exercises lasting less than 60 minutes, while serum leptin levels increased 1–3 hours after exercise in case of running or bicycling and that this inhibition in serum leptin levels lasted more than 24 hours.

Studies about leptin and exercise have generally focused on acute exercise and changes in serum leptin level. However, very few studies have focused on chronic exercises in order to investigate the lasting effects of leptin hormone on the body.

We carried out our study with professional athletes who have been exercising 5 times a week and played a match a week for at least 5 years in order to understand this chronic effect. In this study resting leptin levels of athletes were found three times less than those in the control group (p=0.003). In addition, a negative correlation was found between serum leptin level and VO_2Max use.

A study concerned with the relation between chronic exercise and serum leptin levels was conducted by Merino Gomez et al. [22]. In the study including 26 male soldiers in France, it was stated that there was a three-fold decrease in serum leptin levels after 4 weeks in comparison to the levels at the beginning, although there was no change in BMI.

In a study including highly obese 38 females and 16 males (BMI = 42 kg/m^2, serum leptin levels 19 ng/ml for men and 41 ng/ml for women) Sartorio et al. [13] showed that energy-limiting diet and aerobic exercise brought about a significant weight loss together with a decrease in serum leptin levels (30 ng/ml in women and 11 ng/ml in men).

Various research teams investigated the changes in serum leptin levels with different modes of exercise and demonstrated that exercise did not affect serum leptin levels unless sufficient intensity and duration. Zafeiridis et al. [23] stated that there was no difference between serum leptin levels before, after and 30 minutes following maximum stretching, muscle hypertrophy, endurance and resistance exercises. In a study, Zoladz et al. [5] did not found any difference in serum leptin levels after slow (60 rpm) and fast (120rpm) bicycling exercise made below 70% of VO_2 Max.

In studies carried out with obese and hyperlipidemic patients Yan et al. [10] reported that serum leptin levels had a positive correlation with body weight and BMI. Meier et al. [9] showed in their study including morbid obese patients that serum leptin levels were directly related with BMI. Serum leptin levels in the group with 22 kg/m^2 BMI were found to be 7 ng/ml, whereas the levels were 52 ng/ml in the group with 45 kg/m^2 BMI.

In conclusion, regular and long-term exercise increases fat metabolism of the body, thereby bringing about a decrease in body fat rate, an increase in maximal oxygen consumption and an increase in the period of time during which exercise can be continued. Although the increase in serum leptin levels is in direct proportion with BMI, the main determinant of serum leptin levels is body fat rate. Long-term and regular exercising (adaptation to chronic exercise) increases fat metabolism and reduces body fat rate besides leading to a decrease in serum leptin levels.

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