Serum leptin level in healthy sedentary young men after a short-term exercise

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The effects of an 8 weeks endurance training program on body characteristics and serum leptin concentration were investigated in sedentary young men. The body mass index, body weight and body fat percentage of healthy, sedentary university students were recorded before and after the exercise program and their relationship to serum leptin level was attained. Body fat percentage after training considerably decreased (p<0.01). However, decreases in body weight and mass index and serum leptin level by the exercise program were insignificant. Correlation analysis did not confirm a relationship between serum leptin concentration and body fat percentage before (r = 0.08) and after (r = 0.10) 8 weeks endurance training program. On the contrary to current knowledge that the body fat content is a major determinant of serum leptin level, our results showed that regular exercise caused body fat percentage reduction, which was not accompanied by reduction in serum leptin concentration. This suggests that other factors may influence or regulate serum leptin level in sport doers.

Key words: Leptin, exercise training, body fat percentage.

INTRODUCTION

Leptin was discovered in 1994 following the isolation of the ob gene. It is a protein with a helical structure similar to cytokines with a relative mass of 16 kDa that assists in the regulation of body weight (BW) and energy homeostasis (Ahima, 2000; Pellymounter et al., 1995; Zhang et al., 2002). Leptin has an inhibitory effect on the activity of acetyl Co-A carboxylase that decelerates fatty acid synthesis. Thus, leptin decreases fatty acid and triglyceride synthesis, increases lipid oxidation, and reduces fat storage (Lau et al., 2001).

The leptin level is directly related to body fat (BF) content and body mass index (BMI). It is an important regulator of food intake and controlling BW. Professional athletes have lower leptin levels than healthy sedentaries (Unal et al., 2005). Leptin is regulated by the status of fat storage, with larger adipocytes containing more leptin than smaller ones in the same individual (Hamilton et al., 1995). Aerobic exercise increases the use of free fatty acids, decreasing at the same time BF.

Weight loss is associated with a reduction in leptin levels and weight gain is associated with an increase in leptin levels. In humans, leptin circulates in proportion to the amount of adipose tissue in the body. Obese subjects with greater than 27 kg/m² BMI have on average four times more serum leptin concentration than lean individuals (Considine et al., 1996, 1997).

Other known factors that correlate with plasma leptin levels are age (Ostlund et al., 1996), gender (Ostlund et al., 1996; Hickey et al., 1997), insulin and glucose levels (Boden et al. 1996), and food intake and fat distribution (Bennett et al. 1997). The objective of this study was to investigate the effects of exercise on serum leptin levels in sedentary young men.

MATERIALS AND METHODS

Subjects

Thirty-one healthy male university students were enrolled in the study. The mean age, BW, height, BF percentage, and BMI were 24.3 ± 2.7 years, 75.6 ± 2.3 kg, 175 ± 1 cm, 15.2 ± 0.4% and 24.3 ± 0.3 kg/m², respectively. All subjects were properly informed about the experiment and written consent was obtained.

Exercises

The participants were not engaged in any sports other than their daily routine activities. The target intensity of the assigned exercise
Table 1. Duration and intensity of the training program*.

<table>
<thead>
<tr>
<th>Week</th>
<th>Duration (min)</th>
<th>Intensity (%)</th>
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<tbody>
<tr>
<td>1</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>50</td>
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<td>3</td>
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<td>4</td>
<td>40</td>
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<td>5</td>
<td>45</td>
<td>60</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>70</td>
</tr>
<tr>
<td>7</td>
<td>55</td>
<td>70</td>
</tr>
<tr>
<td>8</td>
<td>60</td>
<td>70</td>
</tr>
</tbody>
</table>

*Sessions were carried out three days per week.

Table 2. The physical characteristics and leptin levels of the students at the beginning and end of the training period.

<table>
<thead>
<tr>
<th>Time relative to exercise training</th>
<th>Response variable(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BW (kg)</td>
</tr>
<tr>
<td>At the beginning</td>
<td>74.03</td>
</tr>
<tr>
<td>At the end</td>
<td>73.46</td>
</tr>
<tr>
<td>SEM</td>
<td>1.92</td>
</tr>
<tr>
<td>P &lt;</td>
<td>0.77</td>
</tr>
</tbody>
</table>

\(^1\)BW = body weight; BFAT = body fat; BMI = body mass index. SEM = standard error of a mean.

Blood analyses

Blood samples were taken from all subjects while resting at the beginning and end of an 8 week exercise program. Samples were drained from the antecubital vein into sterile test tubes. The tubes were centrifuged at 4500 rpm for 10 min at 4°C for separation of serum. Aliquots were frozen at -20°C until analysis. Serum leptin level was measured by the ELISA method using a commercial kit (Leptin EASIA, Cat #: KAP 2281, Lot #: 094203, Biosource, Belgium).

Statistical analysis

Body characteristic measurements and serum leptin level before and after the exercise program were compared using independent t-test (SPSS, Ver. 11.5.0, Chicago, IL). The relationship between BF percentage and serum leptin level was assessed by Pearson’s Correlation analysis. The data were presented as least-square mean ± standard error of a mean (SEM) and statistical significance was considered at P<0.01.

RESULTS

All subjects successfully completed the training program. There were no changes in BW, BMI, and serum leptin level at the end of the training program relative to the beginning (Table 2; Figure 1). The mean BW, BMI, and serum leptin level were 73.75 kg, 24.10 kg/m\(^2\), and 1.62 ng/ml, respectively. However, BF percentage decreased 15.17 to 13.9% during the exercise program (8.5%; P<0.001). Body fat percentage was not correlated with serum leptin level at the beginning (Figure 2) and end (Figure 3) of an 8 week exercise program.

DISCUSSION

There are several reports on the effects of training on leptin levels. In this study the leptin response to a short-term endurance training was measured in healthy sedentary university students. Our results showed an insignificant reduction in serum leptin level (Figure 1; Table 2). This is consistent with previous studies in which no significant changes in leptin levels were found after a short-duration exercise (Ostlund et.al. 1996; Hickey et.al. 1997) or after relatively low-intensity exercise reaching 50% of \(VO_2\text{max}\) (Kennedy et al., 1997; Hickey et al., 1997). It should be pointed out that the response was investigated immediately post-exercise (Considine, 1997; Kennedy et al., 1997) or four hours after exercise (Hickey et al., 1997). In most cases there is no acute effect of exercise on circulating leptin. Hickey et al. (1996) found no change in blood leptin even after correction for hemo-concentration during a 2 h run by fasted, well-trained subjects.
young men. Similarly, circulating leptin levels were not altered by 10 to 12 min of cycling followed by a VO$_2$max test (Considine et al., 1996).

Racette et al. (1997) observed no exercise effect on arterial plasma leptin, venous plasma leptin, or leptin production when subjects cycled for 60 min at 50% of VO$_2$max. Furthermore, plasma leptin was not acutely decreased by running at 70% VO$_2$max long enough to burn 3.320 or 6.225 kJ (Essig et al., 2000). Weltman et al. (2000) found that 30 min of exercise at various intensities and caloric expenditure (from 623±46 kJ to 2.195±187 kJ) in 7 healthy young men did not change leptin levels during exercise or after 3.5 h recovery (Weltman et al., 2000). In this study, the intensity and the duration of the exercise did not appear to be sufficient enough to affect the leptin concentration in these young subjects. There are many other studies in which no changes in serum leptin concentrations were found immediately after exhaustion (Hickey et al., 1996; Torjman et al., 1999) unless exercise routines were of sufficient intensity and duration (Zafeiridis et al., 2003; Zoladz et al., 2002).

The intensity of the exercise is an important factor that affects the serum leptin level. Leal-Cerro et al. (1998) reported a decrease in serum leptin levels after a marathon where athletes spent 11,620 kJ energy. In the present study healthy, sedentary male university students ran 25 to 60 min three times a week for 8 weeks reaching 50 to 70% intensity of maximum heart rate. Although there was a decrease of serum leptin levels, these were not significant (Figure 1) indicating that such training routine is not enough to reach the level of energy expenditure necessary to alter serum leptin levels. Unal et al. (2005) examined leptin responses in professional football players and healthy sedentary males. Their results indicated that the BMI of athletes was higher than
that of sedentary subjects and that the leptin levels of active players were significantly lower than in healthy non-exercising subjects, concluding that BF was a major determinant of serum leptin level. Such result is not consistent with our findings. Following the exercise routines resulted in a significant reduction of BF percentage, but had no effect on serum leptin (Figure 1; Table 2). Moreover, serum leptin level was not correlated with BF percentage (Figures 2 to 3). A significant relationship between regular physical training and leptin levels remains unconfirmed (Robert et al., 2006). In general, studies tend to report either no effect of exercise on leptin concentrations with short-term training, unless the training was associated with fat loss, or a reduction in leptin levels beyond that accounted for by reduction in fat mass in long-term training studies. In a study by Nindl et al. (2002) the leptin concentrations were determined following 50 sets of resistance exercise: 15 sets squatting, 15 sets bench press, 10 sets leg press and 10 sets of pull downs resulting in an average energy expenditure of 3.550 ± 473 kJ. There was a reduction of leptin levels relative to controls after 9, 12 and 13 h exercise. This decline in leptin concentration is not due to fat mass loss but it is likely associated with the disruption in metabolic homeostasis created by high-intensity, sustained energy expenditure and subsequent excess post-oxygen consumption from acute exercise. Several factors must be considered to interpret the leptin levels. Sinha and et al. (1996) reported that exercise training might produce alterations in the production and/or clearance of leptin that could not be reflected by a single plasma measurement of leptin levels at a given point in time. Another important point the interpretation of the leptin levels is the presence of inter-individual differences. There is now evidence that leptin circulates in either a free form (presumably the bioactive form) or is bound to leptin-binding proteins and that the ratio of these two forms varies between lean and obese individuals. The time of measurement is also important. Several studies suggest that short-term exercises (<60 min) and exercises that generated energy expenditure lower than 3.320 kJ do not influence leptin concentrations (Kraemer et al., 2002). Essig et al. (2000) and Van Aggel-Leijssen et al. (1999) also observed significant decreases in plasma leptin 48 h after an exercise session. Essig and colleagues found a significant decrease in leptin at 48 h after 6.225 and 3.320 kJ exercise sessions. These results can be attributed to changes in the body's energy balance. A number of studies have investigated the effects of training on leptin concentrations. These studies have tended to report either no effect of training on leptin concentrations with short-term training (< 12 weeks), or a reduction in leptin levels in long-term training (≥ 12 weeks) studies.

The observation that plasma leptin levels were not affected immediately after exercise is consistent with many other studies (Unal et al., 2005; Kraemer et al., 2002). Occurring within a certain period after exercise is caused by changes in the energy system. A long-duration, moderate intensity bout of exercise expending 3.700 kJ causes a decrease in plasma leptin concentration for up to two-day post-exercise, while a short-duration, maximal-intensity exercise bout shows no effect. In this study an energy balance was not performed.

**Conclusion**

In sports doers there was no correlation between body fat percentage and serum leptin level. Although body fat percentage decreased by a short-term, moderate intensity exercise, serum leptin level remained unchanged.
This could be related to less fat mass in athletes.

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REFERENCES


