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The Effects of Leptin and Insulin Hormones on Health, Body Fat Percentage of the Endurance Athletes

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ABSTRACT The purpose of this study was to compare the effects of the levels of leptin and insulin hormones on body fat percentage of the endurance athletes and sedentary participants. The study was conducted on 37 professional cyclists and 45 sedentary participants aged 21-28 and 19–26 respectively. Mann-Whitney U test and t test were used for statical analyses. There was a statistically significant ($p<.05$) decrease on the body fat percentage, leptin and insulin levels of the cyclists who were endurance athletes, and a significant difference ($p<.05$) was found between the glucose and insulin values of the cyclists and the sedentary participants when the pre- and post-test results were compared. It was found that the body fat percentage and leptin values of the sedentary group were high ($p<.05$) but high density lipoprotein value was low ($p<.05$). As a result, the data showed that endurance athletes had higher level of the health promoting behavior than sedentary participants. Also, biological extreme of body fat, circulating leptin concentration is closely related to fat content.

INTRODUCTION

Nowadays, nutrition affects positively physical activity, smoking and stress lifestyle elements of health and risk of cardiovascular disease. Also in cancer, heart disease, hypertension and diabetes in chronic diseases, the morbidity and mortality of lifestyle changes significantly (Karacabey 2005). Cycling is one of the sports in which intensive endurance training is required and the conditions change constantly (Helou et al. 2010). There are many internal and external factors affecting cycling performance. Weather, the environment, emerging technologies, aerodynamic equipment, and development in sport sciences (that is exercise science, nutrition and pharmacology) are examples of external factors. The psychological, physiological, genetic and anthropometric structure of the athlete, training techniques and racing strategies are among the internal factors (Jeukendrup et al. 2001; Faria et al. 2005; Sevim 2006). A large number of studies, in which the effects of aerobic exercise on blood lipids were investigated, are available in the literature (Zorba 2001; Kelley et al. 2011; Hunter et al. 2011; Saygin et al. 2011; Morencos et al. 2012). In most of these studies, increased high-density lipoprotein cholesterol (HDL-C), decreased by low-density lipoprotein cholesterol (LDL-C), total cholesterol and triglyceride levels were observed as a result of aerobic exercises. (Ozhan et al. 2000; Colakoglu et al. 2001; Koc et al. 2008; Wooten et al. 2009; Tsai et al. 2010) It was reported that the people who do regular exercise had lower triglyceride and LDL but higher HDL-C values than the sedentary people did. (Thompson et al. 1991). Muscle glycogen is the major fuel and rapidly depletes during the acute phase of exercise (Kjaer 1998). Exercise elevates whole body glucose production and utilization to meet fuel demands. The leptin cycles is similar to those of thyroid stimulating hormone (TSH), LH, estradiol, and free fatty acids but shows an inverse relationship with cortisol. In some research, it has been shown that long-term exercise leads to a reduction in leptin levels (Emanuel et al. 2006). Insulin is one of the hormones involved in carbohydrate metabolism. While the level of blood insulin decreases during exercise, the level of glucose stays stabile (Karacabey 2009). Normally, the decreases in the blood glucose and insulin levels occur simultaneously. The reason for the decrease in the blood insulin during exercise is not the decrease in blood glucose but the decrease in insulin secretion. This, in turn, depends on the alpha-adrenergic stimulation. Exercise in itself increases glucose intake into the muscles, as a result of this, the working muscle increases the oxidation of glucose. This effect appears to be independent of insulin. Increased glucose utilization during exercise was observed in the diabetic patients. (Torjman et al. 1999; Fahey et al. 2012). Increased glucose tolerance during exercise and even at rest was reported (Yamaner et al. 2011; Manabe et al. 2013). Therefore, the glucose given to trained people will cause less insulin secretion when compared to the normal response. Leptin shows positive correlation with the body weight, body mass index (BMI), fat mass, and body fat percentage. This explains the leptin increase in obesity as a result of excessive production of the *ob gene* (Zorba et al. 2011). In the light of the comments, the purpose of this study was to compare the level of leptin and insulin hormones on body fat percentage of the endurance athletes and sedentary participants.

METHODS

Experimental Approach to the Problem

The primary purpose of this study was to compare the level of leptin and insulin hormones on body fat percentage of the endurance athletes and sedentary participants. The secondary purpose was to investigate gonadal function in male cyclists. Blood samples were taken from the participants in the morning of the first day of camping and 3-5 days before any training to eliminate any possible influences of acute exercising on the hormones.

Participants

Total of 37 professional cyclists and 45 sedentary participants aged 21–28 and 19–26 were included in this study, respectively. Sedentary male participants, who did not engage in regular sports or physical activities, were recruited from Karaelmas University in Zonguldak city. All cyclists reported a minimum of 1.8 h/day and 6 day/week of riding.

None of the cyclists had a history of biking related to head or urogenital trauma that required medical treatment. However, 6 of them described arm, leg, and facial injuries that required only self-treatment. All cyclists used helmets during their sporting activities and were apparently healthy. None of them was taking medications that would alter gonadal function. Although only one of the participants had previously fathered children, none had a history of fertility problems. Testicular volume (with each of the testicles having .15 mL volume as measured by orchidometry) and consistency were within normal limits. All cyclists were professional cycling competitors licensed by the Turkish Cycling Federation. The local Ethics Committee of the Medical School of the University of Karaelmas approved the study. Written consent, drawn in accordance with the University's institutional review board policies, was obtained from all participants after they were informed of all procedures involved including the potential risks of venipuncture.

Laboratory Analyses

The measurement of the total cholesterol, HDL, LDL levels were carried out in a ROCHE Modular system. Auto analyzer and the enzymatic colorimetric method employing a ROCHE model kit while Electrochemiluminescence Immunoassay measured insulin levels in a Roche Cobas device (Roche Diagnostics, Mannheim, Germany) model hormone analyser using chemiluminescence method. Serum FSH and LH levels were measured by Chemiluminescent Microparticle Immunoassay (Architect System, Abbott Laboratories, Abbot Park, IL, USA). The detection limits of both assays were .05 and .07 IU/L, respectively. Serum leptin was measured by an enzyme-linked immunesorbent assay. For all hormonal parameters, the intra- and interassay coefficients of variation ranged between 2-6% and 3-9%, respectively.

Statistical Analyses

Data are presented as the mean ± SD. Mann-Whitney U test was used to compare the nonparametric data (according to the results of the test of homogeneity of variances, each of the following independent variables are considered to be nonparametric data: age, fasting plasma glucose, insulin and leptin). *T*-test was used to compare the parametric data (according to the results of the test of homogeneity of variances, each of the following independent variables BF percent, LH, FSH are considered to be parametric data). Statistical evaluation of the data was done by using the paired-samples *t*-test (via SPSS 13.0 software for statistics). A value of $p<.05$ was considered significant in this study.

RESULTS

In Table 1, the physical characteristics of the subjects were displayed. With respect to physi-

Table 1: Physical characteristics of the subjects

	Groups	*N*	*X*	*SD*	*Sig. (2-tailed)*	*p*
Age (year)	Road cyclist Control	3745	19.0023.00	10.8213.13	.142	*p*>.05
Height (m)	Road cyclist Control	3745	1.761.73	.05.06	.048	*p*<.05*
Weight (kg)	Road cyclist Control	3745	69.9782.66	5.668.99	.000	*p*<.05*

*Significance level is p<0.05

cal characteristics of the subjects, no significant difference was found between Road cyclist and Control in Rank over (p>.05); significant difference was found between Road cyclist and Control in Height (m) (p<.05); significant difference was found between Road cyclist and Control in Weight (kg) (p<.05).

In Table 2, the blood lipid levels and BFP% values of the subjects were displayed. With respect to blood lipid levels and BFP % values of the subjects, significant difference was found between Road cyclist and Control in HDL (mg/dL) (p<.05); no significant difference was found between Road cyclist and Control in triglyceride (p>.05); no significant difference was found between Road cyclist and Control in LDL (mg/dL) (p>.05); no significant difference was found between Road cyclist and Control in total cholesterol (p>.05). Significant difference was found between Road cyclist and Control in BFP (p<.05)

In Table 3, the hormone levels of the subjects were displayed. With respect to hormone levels of the subjects, significant difference was found between Road cyclist and Control in Glucose (mg/dL) (p<.05); significant difference was found between Road cyclist and Control in Insulin (miu/mL) (p<.05); no significant difference was found between Road cyclist and Control in LH (miu/mL) (p>.05); no significant difference was found between Road cyclist and Control in FSH (miu/mL) (p>.05); significant difference was found between Road cyclist and Control in Leptin (p<.05).

DISCUSSION

The findings of this study in terms of the cyclists' percentage of body fat and leptin levels were significantly lower than sedentary occupations. More over the cyclists' lean body mass was significantly higher than sedentary participants. The effect of exercise on leptin via the adrenergic system is believed to sympathy. Dundar et al. (2014) stated that swimming performances of swimmers with different undertakings showed significant changes in the values of glucose and insulin out of complete blood values. In another study, leptin correlates with body mass

Table 2. Blood lipid levels and body fat percent values of the subjects

	Groups	*N*	*X*	*SD*	*Sig.(2-tailed)*	*p*
HDL (mg/dL)	Road cyclist Control	3745	60.0254.53	5.758.10	.003	*p*<.05*
Triglyceride (mg/dL)	Road cyclist Control	3745	98.43103.11	29.4929.04	.473	*p*>.05
LDL (mg/dL)	Road cyclist Control	3745	92.2294.88	26.4922.84	.627	*p*>.05
Total Cholesterol (mg/dL)	Road cyclist Control	3745	158.50157.97	21.2821.27	.911	*p*>.05
BFP	Road cyclist Control	3745	8.7320.68	.952.71	.000	*p*<.05*

*Significance level is p<0.05

Table 3: Hormone levels of the subjects

	Groups	*N*	*X*	*SD*	*Sig.(2-tailed)*	*p*
Glucose(mg/dL)	Road cyclist Control	3745	92.7887.52	7.865.59	.001	*p*<.05*
Insulin(mIU/mL)	Road cyclist Control	3745	5.153.90	2.531.42	.006	*p*<.05*
LH(mIU/mL)	Road cyclist Control	3745	4.343.93	1.711.24	.211	*p*>.05
FSH(mIU/mL)	Road cyclist Control	3745	4.413.88	1.452.03	.186	*p*>.05
Leptin(ng/mL)	Road cyclist Control	3745	1.712.10	1.251.58	.283	*p*<.05*

*Significance level is p<0.05

index ratio and ratio has been shown to be different in obese and lean subjects (Karacabey 2009). Considering the hormonal profile of the subjects in this study, leptin and insulin, the hormone levels of sedentary, cyclist's leptin and insulin, the hormone levels are statistically high. But the two groups of FSH, LH was not found significant difference between the values. Yamaner et al. (2011) stated that mountain bikers' testosterone levels were lower than the control group, insulin and leptin hormones had no activity at these low levels. LH and FSH levels of the two groups were also found to be similar. A number of studies have shown that exercise training is associated with improvements in glucose tolerance and insulin sensitivity (Zorba et al. 2011). In our research we have done with the sedentary group of cyclists body composition and fasting levels of glucose and insulin were measured after training. According to the results of the work that we have done; the level of leptin was significantly decreased after exercise in our study group. Another reason of the height in Sedentary leptin and leptin binding protein in the blood may be an imbalance between. A high proportion of bound leptin may reduce the biological activity of this hormone have made the study, weightlifters and road cyclist maximal muscle strength and power, muscle mass and strength were compared in terms of serum hormones. Weightlifters, road cyclists and sedentary group was found higher values compared to sedentary people. Road cyclists pedaling at high speed, weightlifting, compared to sedentary lifestyle and blood lactate levels were lower. Basal serum concentrations of total cholesterol and the free cholesterol compared to other groups was lower in road cyclist (Izquierdo et al. 2004). Norton et al. (2012) found in their study where 575 sedentary adults involved, attending physical activities at moderate intensity for 30 mins a day for 40 days improved the fasting blood glucose level. Charmas et al. (2007) found that the aerobic exercises accompanied by music performed for about 60 mins at an intensity of 70% HR_{max} decreased the glucose concentration and caused an increase in fat free acids. An increase in GH and a decrease in insulin hormone were observed. No significant difference was seen in cortisone, testosterone and leptin concentrations between pre- and post-exercise tests. Hasbum et al. (2006) implemented an aerobic exercise program for 2 months for 3 times/wk and 45-50 mins per session and 12 healthy subjects (5 females, 7 males) aged 30-60 were involved. Post-test results on BMI, waist-to-hip ratio, blood pressure, lipids, free fatty acid and plasma leptin level were not significant. However, due to insulin sensitivity is decreased plasma glucose and insulin values (Hasbum et al. 2006).An increase in the secretion of the insulin hormone and counter-insulinary system hormones was seen during exercise. Exercise in itself increases muscle glucose uptake and consequently the working muscle increases glucose oxidation, too. This effect appears to be independent of insulin (Karacabey 2009; Hunter et al. 2010). It can be told that the reason of the decreased leptin levels of road cyclists is the decrease in BFP. Irregular and short-duration exercises will have no effect on decreasing BFP, so it can be said that there will be no change in serum leptin level because of decreased BFP and the findings of this study are compatible with the literature. High density lipoprotein (HDL) cholesterol concentrations have been shown to increase with regular endurance exercise and, therefore, can contribute to a lower risk of coronary heart disease in physically active individuals compared with sedentary subjects. It is well established that low plasma HDL cholesterol levels are associated with an increased risk of CHD (Johnson et al. 1985; Charmas et al. 2007). Indeed, a low HDL cholesterol concentration has been shown to be the most prevalent abnormality of the lipoprotein-lipid profile reported among men with documented CHD (Rubins et al. 1995). It is now fairly well recognized that endurance exercise training can increase plasma HDL cholesterol levels. In the light of the explanations, Johnson et al. (1985) in his study examined 6 members of the Irish Olympic Road Cycling Squad and the subjects were exposed to a gradually increasing exercise program (480-640 km/wk) in addition to their regular exercise schedule for 1 year. The subjects were reassessed at six-month intervals along with specific medical and dietary programs. As a result of this study, increased HDL and decreased triglyceride values were found. Trapp et al. (2008) found that high intensity interval training (approx. 40 mins) for 15 weeks caused a decrease on fasting plasma insulin levels of 30 female subjects. Leptin concentrations were also decreased and this was negatively correlated to the decrease on total body mass and the increase in peak VO_2. Azizi (2012) stated in his study that exercising on treadmill at an intensity of 65-85% HR_{max} for 8 weeks, 3 days per week and 30 mins/session caused a decrease in serum leptin levels of 24 sedentary females. This reduction was correlated to body weight loss. Lucia et al. (2001) examined pre- and post-exercise hormone levels of 9 cyclists who participated in Tour of Spain which lasted for 3 days and 90 hours of total cycling time. They found that the cyclists' serum cortisone and testosterone levels were decreased after the race. Anabolic hormones might affect the performance of a road bike. The change in anabolic hormones that further researches may explain it the results and the reasons for change (Izquierdo et al. 2004).

CONCLUSION

Consequently, endurance athletes had higher level of health promoting behavior than sedentary participants. The data also indicated that biological extreme of body fat; circulating leptin concentration is closely related to fat content. Long-term exercise affects the HDL level in positive direction. Also, it increases the level of glucose and insulin; however, it decreases leptin level. The duration, frequency and type of exercises affect health of people positively.

RECOMMENDATIONS

Exercises induced hormonal changes are effected differently by intensity, volume, frequency, and duration. The effect of aerobic and anaerobic exercises on health should investigate more critically in the future research.

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