Testosterone Cortisol Ratio after Two Months Regular Training on Obese Female Students

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Abstract: Testosterone controls and stimulates muscle, bone, skin, and the majorities of human characteristics. Cortisol protects the body against sudden changes through the control of carbohydrates, protein, and fat metabolism. The purpose of this research was to examine the ratio of testosterone to cortisol following an aerobic activity in fat women. Twenty healthy volunteer female subjects (BMI>29) participated in this research. The subjects performed 8 weeks of running program. Blood sample was collected at the start and termination of the protocol. Statistical analysis including independent t-test and Person correlation procedure was used. The testosterone level different following the aerobic exercise (P=0.6). Significant difference was observed between the cortisol level after the exercise program (P=0.008). In addition, no significant differences was present between the testosterone level of the experimental and control group upon the termination of the exercise program (P=0.89). Significant difference was found between the cortisol level of the experimental and control group after the exercise program (P=0.0001). The ratio of testosterone to cortisol was 0.002 nanogram in pretest and changed to 0.005 after the exercise program. The concentration of cortisol decreased. perhaps the intensity of the activities were not high enough to increase the concentration of cortisol level and cause the destruction of muscle cells. Considering the lower level of women in female compared to men, the concentration of this variable remains unchanged following two months of aerobic exercise. As a result, two months of exercise can not lead to stress on testosterone hormone.

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Introduction

Psychoendocrinological research on sexually dimorphic behavior has focused on testosterone which is qualitatively the most potent androgen in males and is present in females at approximately one-tenth of the male serum concentration (1). Testosterone is a powerful anabolic hormone that stimulate and controls the development of muscle, bone, skin, sex organs and spermatogenesis, and most other masculine physical features. Recently, scientists have discovered that testosterone also aids mental function, enhancing both visual and perceptual skills (2, 3). Cortisol is a defense hormone protecting the organism against any abrupt changes in the physiological equilibrium by affecting carbohydrate, protein and lipid metabolism (catabolism) as well as electrolyte balance in many tissues. This hormone, in addition, inhibits DNA, RNA, and protein synthesis and stimulates the degradation of these macromolecules. (2, 3). The ratio between testosterone and cortisol concentration (Ts/Co ratio) is frequently used as an index of the stress level in exercise training. Changes in this ratio are responsible for several training responses such as hypertrophy and strength gain (4, 5, 6). The relationship between testosterone and cortisol is important to clinicians and is critical for athletes. Exercise when performed at a suitable intensity and volume can increase the anabolic stimulus resulting in stronger and larger muscles (7). Numerous instances are available in the scientific literature that show moderate-volume at high-intensity training can increase testosterone, growth hormone, IGF-1 and other anabolic signals that results in improved exercise performance (8, 9).

Research results have demonstrated that rest interval between sets of activities are important factors and when manipulated have effect on work performed in subsequent sets (12,13), the metabolic (14) and hormonal responses to exercise training(10, 11), and training adaptations (12). However, acute response of Co and Ts to different rest interval is not well understood.

Ahtiainen et al (13) observed no significant differences in acute effect of short (2min) and long (5min) rest interval on concentrations of serum total Ts, free Ts, and Co. On the other hand, there were no significant differences in the cortisol levels among the athletes during the 16th week of training, while the

DHEA C ratio in all female athletes was 30% higher than during the first week (Filaire et al., 1998 (14). Competitive situations induced an increase in T and cortisol (C) levels in female rugby and soccer players (15, 16). The testosterone concentration in many other studies also remained unchanged (17, 18). The reduction in the circulating cortisol after the strength training program has been reported for both men (19) and women (20). This drop may be relevant for inhibition of the protein catabolism and furtherance of proteins aggregation through the reduction of their degradation (21). Due to the controversy surrounding the subject, this research was designed to examine the change in level of testosterone and cortisol as well as their ratio following eight weeks of aerobic training program.

Methodology

This was a quasi-experimental research in which 22 female subjects with the mean body mass index above 29 kgm^2 voluntarily participated in eight weeks of progressively increased aerobic activity. The subjects were healthy female sedentary individuals who had no previous history of participation in any types of regular physical activity. The exercise protocol was held twice per week. Following the selection of the samples who met the inclusion criterion, they were assigned into two groups of equal size (n=11) based on their maximum oxygen consumption ($VO_{2\ max}$) capacity. This condition was used to match the exercise capacity of the two groups. In order to assess their $VO_{2\ max}$, the walk and run test was performed for 12 minutes in a track and field area. This test was taken one week prior and after the termination of the exercise program. This time interval between the test and exercise sessions has no significant effect on the level of the variables of interest. Maximum oxygen consumption was calculated by the following equation (22): $VO_{2\ max} = 0.0268 \times (D) - 11.3$.

The demographic information of the subjects is presented in table 1. At the end of exercise protocol (eighth week), the subjects in the experimental group ran approximately a total of 36000 meters. Polar watches made in China were used to monitor the target heart rate predetermined at maximum of 160 to 165 bpm. The subjects were then instructed to walk until their heart rate decreased to 100 bpm. Following the termination of exercise program, blood sample from both groups was collected at the same laboratory. The subjects in the control group did not participate in any regular physical activity program. Testosterone level was measure by radio immunoassay method and using Ca. No68628 kit made by Finland. For the purpose of measuring the cortisol level of serum, immunoassay method and Cortisal Im 1841 kit made in Zech was employed. The levels of testosterones and cortisol were measured at nanogram per liter scale.

SPSS software was used to analyze the data and parametric independent sample t-test was used to analyze the data after Kolmogrove-smirinov confirmed their normality of the dependent variables. Pearson correlation coefficient was employed to test the association between the cortisol and testosterone. All the significance levels were set to α=0.05.

Results

The mean and standard deviations of cortisol and testosterone are presented in table 2. The results of analysis indicated that the mean value of testosterone and cortisone at the start of the training program and following eight weeks of training were 0.572 ng/ml and 0.6 ng/ml, respectively.

This change however was not statistically significant (P=0.6). In addition, the level of testosterone in the control group was not also significant (P=0.58) nor there was any significant difference between the testosterone in the experimental and control group (P=0.89).

Table 2. Characteristics of subjects one week before training

Characteristics	Mean	Standard Deviation
Age (Y)	21.3	1.5
Height (Cm)	161.1	3.7
Systolic Blood Pressure (mmHg)	120.2	5.3
Diastolic Blood Pressure (mmHg)	75.3	3.4
Body Mass Index (Cm^2)	29.8	1.3
Weight before Exercise (Kg)	74.7	3.5
Weight after Exercise (Kg)	72.6	3.8

The mean value of cortisol in the experimental group before the start of the running program was 193.9 ng/ml and changed to 101.9 ng/ml after the termination of the exercise program. This change was statistically significant (P=.0.008). The mean value of cortisol level in the control group before the start of activity was 210 ng/ml and following the termination of the exercise program changed to 217 ng/ml. Such different however was not statistically significant (P=0. 94). The result of analysis of data showed that there was a significant difference between the control and the experimental group in the post test state (P=0.0001). The mean value of the cortisol level in the experimental group increased following the eight weeks of physical activity.

In addition, Pearson correlation method showed a significant relationship between the testosterone and cortisol (r=0.45, P=0.047). The ratio of testosterone to cortisol in the pretest time in the experimental group was 0.002 ng/ml and decreased to 0,005 ng/ml in the post test time (table 2). These changes in testosterone and cortisol levels are presented in figure 1 and 2, respectively.

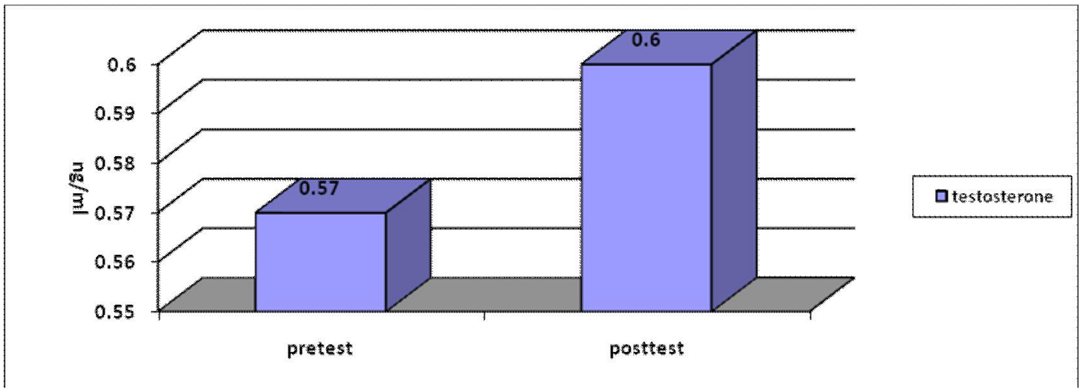

Figure 1: testosterone level change in pre and post time

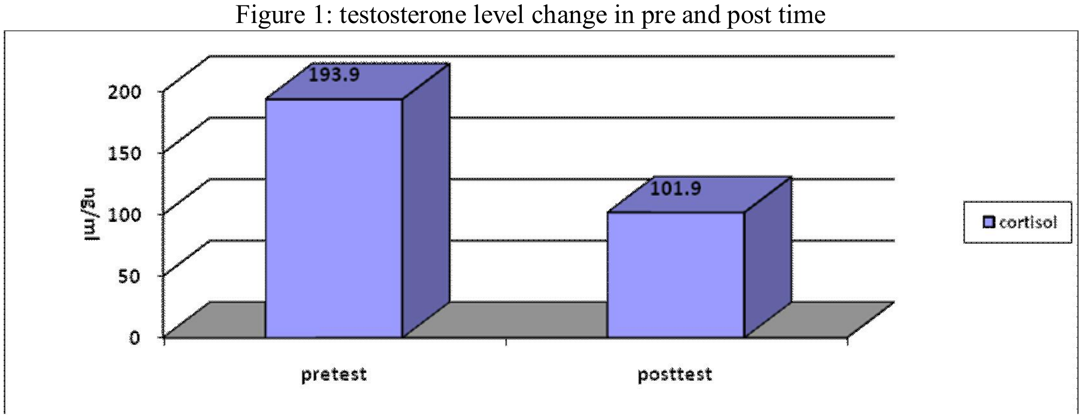

Figure 2: Cortisol level change in pre and post time

Table 2: Mean, standard deviation and ratio of Testosterone and cortisol in ng/ml scale

variables	Mean ±sd	P-value	t-value	Ratio
Testosterone- pretest (ng/ml)	0.572±0.26	0.53	0.6	
Testosterone- posttest (ng/ml)	0.6±0.22			
Cortisol- pretest (ng/ml)	193.9±9.3	0.008	3.33	
Cortisol- posttest (ng/ml)	101.9±4.14			
Testosterone/ Cortisol- pretest (ng/ml)	-	-	-	0.002
Testosterone/ Cortisol- posttest (ng/ml)	-	-	-	0.005

Discussion

In this research, the changes in cortisol and testosterone level as well as the ratio of these variables in nanogram per liter was examined in sedentary women following participation in intermittent physical activity program that lasted for eight weeks. Despite the increased level of testosterone as much as 4.89 percent in the post exercise time compared to the pretest level in this group, the change was not statistically significant. Probably the time of exercise protocol or the intensity was not sufficient to produce a significant change in this variable. In addition, the results of analysis showed that there was no significant difference between the levels of testosterone in the exercise group compared to the control group at the end of the exercise program.

The mean value of the cortisol in the exercise group after the termination of the exercise protocol decreased 47.44 percent. This difference was statistically significant. Based on these results, it was concluded that such exercise program is sufficient to produces significant change in the cortisol level of sedentary obese women. The results of analysis of concentration of cortisol in post test state of both group showed significant difference. The concentration of the cortisol in the exercise group compared to the control group decrease by 112.9 percent.

In addition, the value of testosterone to cortisol level was 0.002 in the pretest condition and changed to 0.005 (ng/ml) in post exercise time. This change is relatively small and probably may not be considered a reliable physiological index for acceptance or rejection of a hypothesis. The findings of the present study did not agree with the results reported by Bateup et. al (2002) and Edwars et al, (2006) who examined the changes in level of testosterone and cortisol in rugby and soccer players, respectively (5, 6). Such result may be attributable to the fact that these authors examined the changes of testosterone and cortisol levels in the competitive sports whereas this research examined the changes of these variable following 8 weeks of physical activity. The findings of the present research is in agreement with the results reported by Krammer, Marxs, and Goldpting who showed that cortisol level decreased after male and female subjects participated in strengths training programs. They concluded that this decrease causes catabolism and accumulation of protein (19, 20, 21). The threshold is approximately 50 to 60 percent of VO 2 max. When this work intensity is below 50 percent of VO 2 max, it leads to decrease in cortisol level in blood since the rate of removal and elimination of this hormone in such types of activities is more than its rate during the rest. Thus, the level of cortisol in this condition can be even less than what it is at the rest state (20). However, it depends on the intensity of the activity. Due to the rest interval between the activity sessions in this research protocol, it seems like the intensity of the exercise has been less than 60 percent of $VO_{2\ max}$ and for this reason the level of cortisol in the blood of the subjects has decreased.

It seems like following eight weeks of physical activity the level of testosterone decreased since its concentration in women is one tenth of men. Therefore, the change in this hormone is negligible and thus is not detected statistically. Due to this fact, the ratio of testosterone to cortisol is not a valid index to determine the stress and intensity level of exercise in female subjects. The association of this two catabolic and anabolic hormones was also poor (r=0.45) in post test state in the experimental group. This finding was in agreement with the findings of Daly and associates (2005) who did not reported any significant correlation between these two hormones (23).

In summary, it may be concluded that various types of physical activities lead to different hormone responses such as cortisol and testosterone. The changes in these aforementioned hormones seems to depend on many factors including physical fitness and mental state of the participants in addition to the different types of work intensity, duration of the activity and the volume of the work. During the moderate aerobic physical activity like the one employed in this research, the level of testosterone does change significantly, but the level of cortisol decreases and this change is statistically significant. One of the limitations of this study was the absence of having several work intensity with more duration of work program. More controlled research is needed to make firm conclusion about what intensity of aerobic work is necessary to change the level of both testosterone and cortisol hormones and their ratio.

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