

## Changes of insulin-like growth factor-1 and cortisol levels following the Wingate anaerobic test among female athletes and non-athletes

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### Abstract

*Introduction:* The aim of present study was to evaluate the changes of insulin like growth factor-1 (IGF-1) and cortisol levels following the Wingate anaerobic test among female athletes and non-athletes.

*Material & Methods:* Twenty four female consist of twelve female athletes (mean age: 45 years of old) and twelve sedentary female (mean age: 44 years of old) voluntary to participate in this study as the subject. All the subjects performed the 30-second Wingate test as the anaerobic exercise. Blood samples collected at rest, end of the Wingate test, and 24 h after intervention for IGF-1 and

cortisol determination. Repeated measure ANOVA test was used to evaluate hormonal responses to the anaerobic test.

*Results:* The results indicated that cortisol levels decreases after the Wingate test in the female athletes compare to the non-athletes ( $P < 0.05$ ). Our results revealed that cortisol levels were lower in the female athletes than the non-athletes ( $P < 0.05$ ). For IGF-1 no significant changes were observed in the female athletes or non-athletes in response to Wingate test.

*Conclusion:* Our results suggested that regular exercise caused hormonal adaptation among female athletes in response to acute anaerobic training.

**Keywords:** Anaerobic exercise, Female athletes, Hormonal adaptation, Glucocorticoids

## 1. Introduction

Stress has been a research topic for over 100 years and historically, the paramount early leader in the study of stress was Hans Selye. Classic observations and studies by Selye during the early part of the 20<sup>th</sup> century led to the development of the “General Adaptation Syndrome” theory of stress response (1). This theory proposes an intimate involvement of the adrenal gland, specifically the cortex, in the adaptation and mal-adaptation process to all forms of stress. One form of stress to the human body is exercise and the exercise training process (2). Specifically, for sedentary individuals, exercise is a distress (negative), but as the body accommodates and adapts, exercise transitions to a eustress (positive) (1-3). Selye viewed the adrenal cortex response (i.e., in humans the primary adrenal cortex hormone is the glucocorticoid cortisol) as critical to the positive adaptation to stress. Regrettably, some researchers in the exercise sciences, as well as some sports enthusiasts, have proposed that cortisol has a counter-productive role in exercise and can lead to a mal-adaptation to the exercise training process (i.e., its catabolic nature) (4). Most certainly cortisol has catabolic actions in the human body; however, in many respects these actions can be beneficial and productive in the response to the stress of exercise and exercise training (5). The view by some exercise specialists

that increases in cortisol can lead to a predominance of catabolism in the body, which results in undesirable aspects within the adaptation of athletes in sports training, is an over-simplification of the hormonal actions of cortisol. This simplified and incomplete notion regarding the role-action of cortisol during exercise training has even resulted in the development of nutritional-pharmaceutical supplements and dietary strategies which attempt to suppress cortisol levels at rest and in response to exercise (5-7). Such actions may in fact actually compromise the ability of select physiological systems to respond and adapt to the stress of exercise (8). Studies in the literature have pointed out an increase or decrease in cortisol in response to physical exercises (9-11).

Insulin-like growth factor-1 (IGF-1) is another critical hormone in metabolic functions, increased protein synthesis, and fat burning (12). The IGF-1 is a polypeptide produced in the liver and muscle and controlled by the GH through the hypothalamic-pituitary axis. Research indicated that the intensity and duration of muscle contraction are two important factors in releasing IGF-1 (12). However, exercise has resulted in inconsistent effects on IGF-1 serum levels. Previous studies indicated increases, reductions, and no changes in the IGF- responses following the exercise protocols (13-16). According to the controversial issues result regarding hormonal adaptation to long term exercise, this study aimed to investigate the cortisol and IGF-1 responses to an anaerobic Wingate-test in athletes and non-athletes.

## **2. Material & Methods**

### *Subjects*

In this quasi-experimental study, twenty four healthy women categorized into athletic and nonathletic groups (12 participants in each). Athletes participated in physical exercise for four sessions a week for at least three years. The subjects were given both verbal and written instructions outlining the experimental procedure, and written informed consent was obtained.

### *Study protocol*

The test procedures were explained to the subjects and consisted of 5 minutes cycling warm-up followed by the anaerobic Wingate Test performed on a stationary bicycle (E834, Sweden). The resistance load was adjusted to 75 g/kg body weight and subjects were encouraged to pedal as fast as possible for 30 seconds. Blood samples were collected 20 minutes pre, immediately post and 24 hours post-Wingate test. Serum fasting cortisol and IGF-1 were estimated by enzyme-linked immunosorbent assay (ELISA) using Monobind kits (USA). All experimental protocols performed in Shiraz, Iran.

### *Statistical analysis*

Kolmogorov–Smirnov test was used to assess the normality of the data distribution. The dependent sample t-test and repeated measure ANOVA test followed by Bonferroni post hoc were used to identify the differences. All data presented as mean  $\pm$  standard deviation. The  $P \leq 0.05$  was considered as being statically significant. All statistical procedures were used by SPSS software (version 21.0, Chicago, IL, USA).

### **3. Results**

An independent T-test was conducted to compare the effect of anaerobic Wingate test on IGF-1 and cortisol levels between female athlete and non-athlete at 20 min pre, immediately, and 24 hours post-Wingate test. There was not a significant difference in IGF-1 levels between groups in immediately ( $P = 0.24$ ) and post-Wingate test ( $P = 0.47$ ). There was a significant reduction in cortisol levels in athletes compared to non-athlete at immediately ( $P = 0.01$ ) and 24 hours after the Wingate test ( $P = 0.02$ ) (Table 1). The repeated measure ANOVA was conducted to compare the effect of anaerobic Wingate test on IGF-1 and cortisol levels in pre, immediately, and 24 hours post-test in both groups. There was no within-group difference in IGF-1 in female athletes ( $F = 0.61$ ,  $P = 0.45$ ), and non-athlete ( $F = 0.70$ ,  $P = 0.42$ ) (Table 1). There was not a significant difference in cortisol levels in non-athlete ( $F = 1.91$ ,  $P = 0.2$ ), and there was a within-group significant reduction in cortisol levels in female athletes ( $F = 2.36$ ,  $P = 0.03$ ).

Table 1. The mean  $\pm$  SD of serum IGF-1 and cortisol levels in pre, Immediately, and 24 hours post- anaerobic Wingate test in female athletes and non-athletes.

		20 minutes Pre	Immediately post	24 hours post
Athletes	IGF-1	127.98 $\pm$ 10.2	117.80 $\pm$ 9.8	123.70 $\pm$ 11.0
Non- athletes		135.30 $\pm$ 11.4	135.60 $\pm$ 12.7	134.60 $\pm$ 16.8
Athletes	Cortisol	118.84 $\pm$ 10.5	102.01 $\pm$ 9.9*	107.05 $\pm$ 17.9*
Non- athletes		137.79 $\pm$ 11.3	135.60 $\pm$ 14.3	133.43 $\pm$ 17.1

\* significant differences (P<0.05)

#### 4. Discussion

The present study aimed to evaluate the changes of IGF-1 and cortisol levels following the anaerobic Wingate test among female athletes and non-athletes. The results indicated that serum IGF-1 level was not changed, however, the cortisol level decreased in response to the Wingate test in the female athletes compare to the non-athletes. There are some controversial pieces of evidence regarding IGF-1 and cortisol levels following exercise.

Consistent with our findings, some studies revealed no significant changes in serum IGF-1 levels following 10 min treadmill running 85% VO<sub>2</sub> peak (16) and 40 min cycle 75% HR in women (17). Some studies indicated decreased levels of serum cortisol following endurance and resistance exercises in young men (10,11). In contrast, one study showed an increased level in cortisol serum following one session of high-intensity aerobic exercise in men (9). Some studies showed an increased level of IGF-1 and no change in cortisol as a result of 8 weeks treadmill running exercise in adolescents (18) and young men (19). In one study IGF-1 increased significantly as a result of endurance training alone or combined with resistance exercise (11). Another study presented that resistance exercise increased IGF-1 in athletes (20). The differences between results are due to exercise training protocol including the kind, intensity, and duration of exercise (21). An anaerobic test in our study versus resistance exercise (20) did not alter IGF-1 levels in athletes. However, a systematic review article indicted that all exercise protocols from low to high intensity and short to long-duration alter IGF-1 serum levels, although, the type of exercise has a key role in systematic IGF-1. Systemic IGF-1 level will more increases as a result of endurance

training compared to resistance exercise (12). Therefore, lack of endurance exercise in exercise protocol of athletes can induce no change in IGF-1 level in our study. Other factors such as demographic information including age, gender, baseline physical fitness, and body composition made the differences. The evidences indicated that hormonal responses to physical activities depend on intensity, duration, type of exercise program, and level of physical fitness of the subjects (22). Cortisol increases extensively following high-intensity short term exercises when the workload is above the critical threshold (50 to 60% maximal oxygen uptake) (23). The threshold intensity gradually increases as a result of long-term physical exercise; therefore, the serum cortisol level is lower in athletes compared to non-athletes in the same intensity of workload. During high-intensity exercise, cortisol secretes highly (8), however, the increase is not displayed until recovery-period, due to the short duration of such exercises. In recovery-phase, cortisol releasing in normal amounts leads to restoring homeostasis of the body after exposure to exercise. Catabolic effects of cortisol and anabolic effects of IGF-1 resulting in increased enzymatic and structural proteins in muscle fiber (8). The decreased levels of cortisol in athletes group can be due to the higher threshold to cortisol responses resulting from adaptation to prolong exercise, increased regulation of glucocorticoid receptor resulting from adaptation to resistance exercise (24), the balance between releasing and eliminating of cortisol, and reduction in ACTH activity. In general, an important factor to design a physical exercise program is the kind and volume of training to obtain the most anabolic effects.

## 5. Conclusion

According to the present findings, regular exercise causes hormonal adaptation among female athletes in response to acute anaerobic training.

**Conflict of interests:** The authors have no conflicts of interest to declare.

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