



## Serum Testosterone/cortisol ratio in response to an Eccentric resistance exercise in non-trained boy students

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**ABSTRACT:** A growing body of literature suggests that intense eccentric exercise for first session can be associated with catabolic property in inactive individuals. Based on these data, in present study, we aimed to assess acute response of testosterone and cortisol as anabolic and catabolic hormones as well as ratio between them to an intense eccentric resistance test included a 20 minutes up and down the bench 60 cm with a weight equivalent to 13 percent of his weight in non-trained boy students. For this purpose, twenty-four non-trained boy students age-matched (18-24 years) were participated in this study. Blood samples were collected before and immediately after above mentioned exercise test for measure serum testosterone and cortisol and ratio between them. Pre- and post exercise serum of biochemical markers were compared between conditions using a paired-samples t-test. The results were considered statistically significant for  $p < 0.05$ . Compared to pre-test, serum testosterone and cortisol concentration increased significantly after exercise test in studied subjects, but testosterone/cortisol ratio did not change. A session eccentric resistance test is not associated with anabolic property in non-trained individuals.

**Keywords:** Anabolical property, Testosterone/cortisol ratio, Eccentric resistance exercise

### INTRODUCTION

Muscular power and volume increase is definitely among the main objectives of strength exercises. But, if anabolic processes do not overcome the catabolic ones, not only will not these contractions bring about muscle volume, protein synthesis, and obtaining power, but also reduce muscular volume and power by decomposing and breaking down muscular proteins. Hence, determining anabolic to catabolic ratio is one of the measurement indices of the optimum effects of the strength exercises. On the other hand, anabolic and catabolic processes strongly depend on hormonal changes and profile. This is because hormonal alternations - depending on the type of activity, diet, and the individual characteristics of an athlete are amongst the key components affecting protein synthesis or decomposition. If exercise protocol or exercise test results in a negative balance between anabolic and catabolic components, it will absolutely depend on the type of diet or the amount of protein (Phillips, 2004).

It is supposed that testosterone to cortisol ratio regulates anabolic to catabolic process ratio at the time of returning to the basic state. Accordingly, any change in this ratio is a critical sign. Perhaps, it is the cause of hyper-exercise syndrome. However, reviewing this ratio in an individual activity session can indicate exhaustion. This is because hyper-exercise syndrome is resulted from several successive exhaustions. Testosterone ratio is used for measuring individuals' response to exercise and predicting their performance capacity. A high ratio shows anabolic conditions. A

ratio of 30% or lower shows catabolic conditions. An exercise session creates short term changes in anabolic and catabolic equilibrium. It depends on the intensity and duration of an exercise session (Kraemer *et al.*, 1998). Regarding the intensity and duration of the activity, anabolic-catabolic balance temporarily changes. Hard repetitive exercises without adequate and appropriate recovery can induce long deregulation and disorder in anabolic-catabolic balance. This ratio also reduces in proportion with the increase of the intensity and duration of physical exercises. The main function of cortisol is summarized in its metabolic quality. That is, it leads to the decomposition of tissues and muscles by its metabolic function. High levels of cortisol remain up to 2h after an exercise session. It probably points out the stress-killing effects of cortisol. Cortisol levels increase resulted from nervous and physical pressures leads to the decomposition or breakdown of proteins. On the other hand, among androgens, there are higher levels of testosterone in blood circulation. Yet, dihydrotestosterone is biologically more active. Free testosterone portion in blood circulation is partially 1 or 2% of total blood testosterone (Majumdar *et al.*, 2010, Lac and Berthon 2000, Florini, 1987, Wolfson and Neave 2004, Guyton and Hall 1996, William, 1994).

The anabolic effects of testosterone are also approved by many scientific resources. Despite the fact that strength exercises bring about anabolic effects with muscle volume increase.

A question is posed here: is a strength exercise session of extraverted contractions kind in non-athletes accompanied with anabolic qualities? Hence, the present study determines the effect of an extraverted strength exercise session on the levels of cortisol and testosterone and their ratio in non-athletes.

## METHOD AND SUBJECTS

This study aimed to determine the effect of an eccentric resistance exercise test on serum testosterone as an anabolic hormone and serum cortisol as a catabolic hormone and also on testosterone / cortisol ratio in a group of non-trained boy students. Subjects were twenty-four non-trained boy students age-matched (18-24 year). All study participants completed the consent process and provided written informed consent prior to randomization. Participants were included if they had not been involved in regular physical activity/diet in the previous 6 months. None of the subjects used drugs, and none had a past history of disease or injury that would prevent daily exercise. Exclusion criteria included disease, use of medicine, daily smoking.

### A. Anthropometric measures

Apart from the biochemical measurements, additional variables for this report included age, height and weight, body mass index (BMI). Subjects wore light clothing and removed all metal items which could interrupt the electronic current during the measurement. Weight and height were measured in the morning, in fasting condition, standing, wearing light clothing and no shoes. Body mass index (BMI) was calculated as weight (kg) divided by squared height (m).

### B. Exercise test

Blood samples were collected, via the cannulated antecubital vein, between 8:00-9:00 a.m. after an

overnight fasting then centrifuged for separate serum (pre-test). All participants refrained from any severe physical activity 48 h before measurements. Serum used to measuring testosterone (DR Diagnostic Testosterone Eliza-EIA-1559, Germany) and cortisol (G diagnostic KS18EW, England) by ELISA method. After blood samples, the subject of two groups were completed a resistance exercise test. In this protocol, each subject was performed a 20 minutes up and down the bench 60 cm with a weight equivalent to 13 percent of his weight. Blood samples were repeated immediately after exercise test (post-test).

### C. Statistical analysis

All statistical analyses were performed through the use of a statistical software package (SPSS, Version 15.0, SPSS Inc., IL, USA). Normal distribution of data was analyzed by the Kolmogorov-Smirnov normality test. The comparisons between the measurements of the parametric parameters were determined by paired samples t test. The level of significance was set at  $P < 0.05$ .

## RESULTS

As mentioned above, this study aimed to determine acute response of serum testosterone and cortisol and their ratio to an eccentric resistance exercise. Table shows the anthropometrical markers of studied subjects. Data of paired T test showed that a resistance exercise involved high intensity eccentric contraction led to significant increase in serum testosterone in non-trained boy students ( $p = 0.007$ ). A significant increase was also observed in serum cortisol by resistance exercise in studied subjects ( $p = 0.028$ ). But the testosterone to cortisol ratio did not change with exercise test in studied group ( $p = 0.882$ ). Please see Table 2.

**Table 1: Mean and standard deviation of anthropometrical markers in studied. subjects.**

Variable	Mean	Standard deviation
Age (year)	22.3	1.8
Height (cm)	117.2	1.13
Weight (kg)	77.6	7.2
Body mass index (kg/m <sup>2</sup> )	24.73	2.1

**Table 2: Mean and SD of biochemistry markers in response to resistance exercise.**

Variable	Pre-test	Post-test	P value
Testosterone	9.78 ± 2.06	11.1 ± 0.74	0.007
Cortisol	32.2 ± 17.15	49.2 ± 21.40	0.028
Testosterone/cortisol ratio	0.36 ± 0.18	0.35 ± 0.37	0.882

## DISCUSSION

The positive effects of power and strength exercises together with a good-calorie diet on muscle volume and muscular power are approved by several studies. Nevertheless, some questions still remain regarding the effect of intensive extraverted muscular contractions on anabolic and catabolic hormones in non-athletes. In this

study, intensive extraverted muscular contractions led to a significant increase of the serum levels of both cortisol and testosterone in a group of non-athlete students. Yet, according to these findings, it is not possible to emphasize the catabolic or anabolic effects of this exercise test.

Based on the statistical analysis, a strength exercise test session in terms of intensive extraverted muscular contractions leads to a significant increase of the serum levels of testosterone in non-athlete students. Result of this study correlates with Sutton (1977) finding. Yet, in another study by Marco (2004), testosterone levels did not change after eight weeks of heavy strength exercises. His findings do not correlate with the results of the present study. Conflict in these results can be attributed to the intensity and duration of the exercise plan in these studies. That is, strength exercises were used in both studies. Only an intensive extraverted strength contractions session was implemented in the present study; while the exercise session continued for eight weeks. T-dependent test results also showed that one session of a strength exercise test in terms of intensive extraverted muscular contractions led to a significant increase of the serum levels of cortisol in non-athlete students. These results do not correlate with the results reported by Yau Wang *et al.* (2001). This is because, in the respective study, the serum levels of cortisol in adult women were not affected by an intensive strength exercise session. The researcher explained it as follows: the respective hormones response depends on the age range of the individuals under study, type, duration, intensity, and some other exercise variables. Like our results, Beavers (2010) observed a significant increase in the levels of cortisol after a strength exercise session.

Reviewing respective results do not respond this question that an intensive extraverted contractions session is accompanied with anabolic or catabolic qualities. Yet, this question can be responded based on their ratios. In fact, if an exercise activity session leads to testosterone to cortisol ratio increase, it will have anabolic qualities. Yet, in the present study, the testosterone to cortisol ratio of response did not change with exercise test. The result of this study does not correlate with the result of Farzad (2010). This is because, here, the increase of free testosterone to cortisol ratio was reported. The researcher mainly attributed it to the reduction of cortisol serum level. The reduction of cortisol after exercise is probably due to the increase of cortisol removal from blood circulation and (or) the reduction of adrenocorticotrophic hormone activity. On the other hand, results of this study correlate with the findings reported by Braunstein (2006). The researcher ascribes it to the uncertainty of an exact pattern of the hormones ratio in response to the exercise plans. Yet, in a study by Palacios (2007), no changes were reported in the ratio. Based on this evidence, it can be concluded that one session of intensive extraverted contractions is not accompanied with non-athlete men anabolic qualities. Results of the present study correlate with the results of the recent research. This is because testosterone to cortisol ratio reduced immediately after the exercise in Peari's study. Yet, the ratio shifted toward rest values later. Although these changes were not significant, results indicate a catabolic response immediately after aerobic exercises with %60 of maximum oxygen intake. Cortisol increase

was the main factor of testosterone to cortisol ratio reduction. In sum, results of the present study showed that one session of intensive extraverted contractions does not make any changes in testosterone to cortisol ratio in not-athlete young men.

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