The effect of 12 weeks Circuit-resistance training on Cortisol, Body Composition and Muscular Strength in overweight young males

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ABSTRACT: Resistance exercise has increasingly become a mode of exercise recommended for weight management and weight loss in obese individuals. Cortisol is an effective catabolic hormone in metabolism. The purpose of this study was to determine the effect of Circuit-resistance training on plasma cortisol, Body Composition and Muscular Strength in overweight young males. Twenty young males (age 17-19 years and BMI 27.48±1.5 kg/m² (mean ± SE)) were randomly allocated to the intervention and control groups. Subjects performed Circuit-resistance training protocol with 60% 1RM, 3 sessions per week for 12 weeks. The level of cortisol hormone was measured using the ELISA method before and after 12 weeks. The results revealed that Cortisol (P=0.05) declined significantly. Although no significant differences were observed in body weight and BMI, body fat mass decreased and muscular strength increased significantly (P≤0.05). We found that circuit resistance training can improve body composition, muscular strength and physiologic adaptations by decreasing the catabolic state in overweight young males.

Keywords: Circuit-resistance training, Cortisol, Body Composition, Muscular Strength, overweight young males

INTRODUCTION

Resistance exercise has increasingly become a mode of exercise recommended for weight management and weight loss in obese individuals (Thomas et al., 2012). Exercise affects the activity of many glands and the production of their hormones. Cortisol is the primary glucocorticoid secreted by the adrenal cortex and an important regulatory hormone for blood glucose homeostasis (azizi et al., 2012). It is the most potent glucocorticoid produced by the human adrenal cortex and is secreted in response to stress, either physiological or psychological, and plays a prominent role in influencing catabolic activity in skeletal muscle tissue. Cortisol acts through specific intracellular receptors and influences the physiological activity of hormones, enzymes, and nutrients (i.e., insulin for glucose regulation, proteolytic enzymes, protein degradation and conversion of amino acids to carbohydrate) (Mulligan et al., 1996). When young men are to increase body fat mass, cortisol production rates are increased indicating that slight to moderate obesity induced by overnutrition is followed by elevated cortisol secretion (Azizi et al., 2012).

Frank et al (2010) reported that glucocorticoids such as cortisol can be the powerful ruler of immune responses (Frank et al., 2010). It has been reported that long term elevation of cortisol level leads definitely to suppression of immunity (Isowa et al., 2004).

Until now several studies have performed on the effect of exercise on plasma cortisol level (Vasankari et al., 1993; Bosco et al., 2000; Hakkinen and Pakarinen, 1993; Kraemer et al., 1998; Snegovskaya and Viru, 1993). A few Studies have shown that heavy resistance exercise can elicit significant increases in cortisol (Hakkinen and Pakarinen, 1993; Kraemer et al., 1998; Snegovskaya and Viru, 1993). However, some researchers cited that long-term resistance training causes a reduction or no change in the resting cortisol concentration (Vasankari et al., 1993; Bosco et al., 2000).

Resistance training has been recently considered by many people to achieve physical fitness. Considering the few and controversial reports on effects of exercise on cortisol level (Vasankari et al., 1993; Bosco et al., 2000; Hakkinen and Pakarinen, 1993; Kraemer et al., 1998; Snegovskaya and Viru, 1993) and
concerns about the increase in prevalence of obesity and overweight introducing appropriate methods of exercising for weight control is of great importance. Exercise stress indicators can help to achieve a better designing of the exercise protocols. Thus, the aim of this study was to determine the effect of 12 weeks Circuit-resistance training on Cortisol, body composition and muscular strength in overweight young males.

MATERIAL AND METHODS

The subjects
In this study 20 non-athlete overweight (25<BMI<30) young males were voluntarily selected. After taking written consent a questionnaire containing identifying data, past medical history, drug history, smoking status and amount of daily activity was filled by each subject. The subjects were randomly divided to two groups of control (n=10) and intervention (n=10). By measuring their heights and weights, BMIs were calculated using the weight divided by square of height formula. Percentage of body fat was also calculated using Caliper (Lafayette made in America) and Jackson and Pollack’s three points formula by measuring the subcutaneous fat of three muscles (triceps brachii, abdomen and thigh) (table 1).

Training protocol
In this study the Brzycki formula was used to calculate the 1RM (Nascimento et al., 2007).

\[ 1\text{-RM} = \frac{100 \times \text{load rep}}{102.78 - 2.78 \times \text{rep}} \]

Where:
- Load rep: work load value of repetitions performed, expressed in kg;
- Rep: number of repetitions performed.

Participants in intervention group completed a 9-exercises protocol (ie, 9 different lifts) addressing the major skeletal muscle groups. These included chest press, Leg press, Shoulder press, seated rows, Leg extension, Triceps extension, Leg curl, Biceps curl and sit-up. Each exercise consisted of 8-12 repetitions at a weight equivalent to 60% of the subject’s 1 RM. The subjects underwent exercising for 12 weeks, 3 sessions per week. Each session consisted of three circuits and in each circuit 9 movements which were previously mentioned were done one after another. Duration of each movement was 30 seconds (8-12 repeats), duration of resting between two consecutive movements was 30 seconds and duration of resting between the two circuits was considered to be 120 seconds. Each session took a total time of 50-55 minutes. The principle of overload was designed so as after each four weeks of training, 1RM was tested for each subject in each station and the amount of weight for each person was adjusted according to that.

Blood sampling and hormone analysis
Blood samples were taken 24 hours before the first session of the exercise and 48 hours after the last session from the subjects of the both groups. Due to the effect of diet on the plasma levels of hormones effecting the appetite, the diet of all of the subjects before each time of sampling was considered to be equal according to the type, amount and time of having the food. For equalization of time of sampling for controlling the circadian rhythm sampling at the end and beginning of the study was performed after 10-12 hours of fasting at 7:30 AM. For inhibition of destruction of measuring molecules by proteases samples were poured in tubes containing anti-protease cocktail (Gold Bio Company, America). In each sample tube 100λ of the cocktail was added and then 10 mL blood in sitting position was taken from the brachial vein of each subject and was added to the tube containing the cocktail. Then the samples were centrifuged for 10 minutes by 2000 RPM. The obtained serum was then transferred to the laboratory of Research Institute for Endocrine Sciences in Tehran and stored in a –80°C freezer for later analysis. Plasma Cortisol was determined by enzyme immunoassay (Diagnostics Biochem Canada Inc., Ontario, Canada) with a sensitivity of 0.4 mg/dL and an intraassay CV of 6.4%, respectively.

STATISTICAL METHODS

All the variables were checked regarding their normal distributions using the Kolmogorov-Smirnov test and data are presented as means±SD. The Paired-Sample t test was applied to compare variables. Statistical analysis was carried out using SPSS version 18. Statistical significance was accepted at the 5% level.

RESULTS

The physical characteristics of study participants (n=20) are reported in Table 1. There were no significant differences in the demographic data between groups.
The results revealed that after 12 weeks circuit resistance training although no significant differences were observed in body weight (P=0.75) and BMI (P=0.65), fat body mass decreased significantly in exercise group (Table 1).

Kolmogorov-Smirnov test was first used to study the normality of the distribution. The Kolmogorov-Smirnov test revealed that there were no significant differences in baseline cortisol concentrations before each trial. Statistical analysis showed that level of Cortisol decreased significantly (P=0.05) in the exercise group (Table 2, Fig1)

After 12 weeks Circuit-resistance training muscular strength is increased significantly in Chest Press, leg press, shoulder press, Leg extension, Triceps extension and Biceps curl exercises (P≤0.05)( Table 3).

<table>
<thead>
<tr>
<th>Exercise group</th>
<th>PRE</th>
<th>POST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest Press (free weights)</td>
<td>57.78±12.59</td>
<td>70.11±12.88 ††</td>
</tr>
<tr>
<td>Leg press (machine)</td>
<td>214.44±50.06</td>
<td>253.44±34.89 ††</td>
</tr>
<tr>
<td>Shoulder press (free weights)</td>
<td>35.33±6.30</td>
<td>46.44±6.18 ††</td>
</tr>
<tr>
<td>seated rows (machine)</td>
<td>70.33±11.32</td>
<td>74.33±14.67</td>
</tr>
<tr>
<td>Leg extension (machine)</td>
<td>48.11±9.17</td>
<td>68.56±14.28 ††</td>
</tr>
<tr>
<td>Triceps extension (machine)</td>
<td>63.44±13.57</td>
<td>75.67±19.60 ††</td>
</tr>
<tr>
<td>Leg curl (machine)</td>
<td>51.56±9.99</td>
<td>53.33±4.64</td>
</tr>
<tr>
<td>Biceps curl (machine)</td>
<td>63.72±11.21</td>
<td>71.67±11.19 ††</td>
</tr>
</tbody>
</table>

††Significantly (p<0.01) different from resting. Values are mean±SD
DISCUSSION

In the present study, we were following to determine the effect of 12 weeks circuit-resistance training on cortisol level, body composition and muscular strength in non-athlete overweight young males. The primary finding of this study was that 12 weeks of active Circuit-resistance training lead to a significant decrease in the total plasma cortisol concentration. Cortisol, a catabolic hormone released in response to a wide variety of stresses, has received much attention (Mulligan et al., 1996). The level of serum cortisol is affected by many factors such as intensity, duration and timing of exercise, type of exercise, age, altitude, environmental temperature and psychology (Beyleroglu, 2011). Vasankari et al (1993) reported that long-term resistance training causes a reduction or no change in the resting cortisol concentration (Vasankari et al., 1993).

Cortisol's release affects metabolism by attempting to help maintain blood glucose levels during physical exercise; it does this in part by acting upon skeletal muscle and adipose tissue to increase amino acid and lipid mobilization (Brownlee et al., 2005). Kraemer et al (2004) reported that primary functions of Cortisol are increase protein breakdown, inhibit glucose uptake and increase lipolysis (Kraemer et al., 2004). It also aids this process by stimulating the liver to produce enzymes involved in the gluconeogenic and glycolytic pathways allowing conversion of amino acids and glycerol into glucose and glycogen (Brownlee et al., 2005). Its antagonistic nature and concomitant circulation with the anabolic hormones make it of primary interest when investigating anabolic activities of the body (Mulligian et al., 1996). It has been suggested that regular activity may abate muscle gene expression of glucocorticoid-inducible proteins and exercise-induced physical stress particularly in low workloads (Hickson et al., 1990). Both resistance and endurance trainings, decrease glucocorticoid-induced muscle catabolism (Agha-Alinejad et al., 2013). The results of studies (Vasankari et al., 1993; Bosco et al., 2000), indicating that exercise training may reduce resting cortisol levels and cortisol response to physical activity.

Resistance training is a potent stimulus to increase fat-free mass (FFM), muscular strength, and power and thus may be an important component of a successful weight loss program by helping to preserve FFM while maximizing fat loss. These results suggest that some of the increases in muscular strength with training can be attributed to the decreas in resting cortisol levels (Jakicic et al., 2001). There are different mechanisms that might explain the change in the resting level of cortisol following physical exercises, including: hypothalamus; pituitary and adrenal stimulation; HPA and ACTH secretion, central temperature changes, PH changes, sympathetic nervous system mechanisms, Lactate accumulation, hypoxia and stress (Shakeri et al., 2012).

Circuit-resistance exercise for 12 weeks leads to a significant reduction in body fat percentage and an increase in muscular strength and mass in non-athlete overweight young males. These results were gained under a condition that no significant differences were observed in body weight and BMI (P<0.05). Losing weight has been recommended to the overweight people at risk of diseases and disabilities related to obesity, but to enhance health and function, losing weight should be obtained by reducing the fat mass and maintaining the lean body mass (Frimel et al., 2008). In resistance exercise usually the changes in body weight and BMI due to simultaneity of reduction in fat mass and increase in lean body mass in short term (less than 6 months) is not justifiable.

In conclusion, it seems that Circuit-resistance exercise can improve body composition and muscular strength by decreasing the catabolic state in non-athlete overweight young males. Gaining strength and alterations in muscle fiber density have been credited to hormonal activity and complex interactions of physiological systems in response to exercise stress. The exact mechanisms responsible for regulating muscular adaptations are unknown (Mulligan et al., 1996). Therefore additional investigations are needed to clarify the cortisol responses to exercise.

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REFERENCES


