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Effects of 8 week resistance training period, the levels of Cortisol, DHEA, and the ratio of DHEA to cortisol in active young girls

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ABSTRACT

The aim of the present study was to determine the acute and chronic effects of 8 weeks of resistance training interval, the levels of cortisol, DHEA, and the ratio of serum cortisol to DHEA, active young women. 14 subjects were examined in this study were randomly divided into exercise and control groups. Experimental group at 8 weeks of resistance training increased participated. Before, immediately after and two hours after the first test (48 hours before the start of training), and final exam (48 hr after the end of exercise), blood samples were taken from all subjects. Control group at the beginning and end of 8 weeks, blood samples were. To investigate the changes of variables in the training group, the ANOVA with repeated measures was used. The interval training group and control group for comparison, the test T, was used. To investigate the changes of variables in the control group, paired T-test was used. Cortisol at interval training, the linearly and significantly decreased ($P<0.05$). DHEA and DHEA to cortisol ratio, interval training group, the linearly and significantly increased ($P<0.05$). After 8 weeks, serum cortisol levels at rest, in practice, significantly lower than the control group, and levels of DHEA and DHEA ratio of serum cortisol the rest, in practice, significantly, greater than control (for all three $P=0.01$). Recommended active young women, to improve their fitness, strength training rotation, turn. However, more research is needed to examine the effects of resistance exercise is.

Keywords: Cortisol, DHEA, Resistance training, Interval training

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INTRODUCTION

Testosterone and cortisol, a hormone anabolic and catabolic than other hormones have been considered, and the ratio of these hormones is another useful indicator for determining an individual's fitness and the pressures of work and training [1]. However, in girls, usually DHEA to cortisol ratio is used. Cortisol is the most important human

glucocorticoid and adrenal cortical portion is made [2]. DHEA of adrenal hormones, particularly the sex steroids such as testosterone and estrogen into the road, anabolic effects on many tissues, leaves [1,3].

Resistance training, has recently attracted the attention of many people, especially women, fitness goals, is located. Pressure measurement following exercise training program, can better understand the acute and chronic effects of resistance training, and can help. DHEA to cortisol ratio, is considered as an indicator of exercise stress [1] and the pressure overtraining athlete's physiological capacity may not only improve performance, but the performance is weakening. On the other hand, if the pressure in practice, much less have also led to significant improvements in performance, it does not. Further studies on the effects of resistance training on endocrine changes, the level of testosterone in men, fewer studies have focused on women DHEA has been made, training purposes, may be used.
Kvorning et al. (2006), followed by resistance training increases testosterone levels, were reported [4]. Hakkinen et al. (2005), respectively, after 12 and 21 weeks of strength training and endurance, increases the level of DHEA in women inactive, were observed [5]. Tremblay et al. (2004), the changes in resting levels, increased testosterone in response to acute exercise in men showed that after a period of resistance training [6]. Willoughby et al. (2003), potentially reducing the cortisol response to resistance exercise, resistance training followed by a period of at least part of the regulation of the glucocorticoid receptor, known [7]. Chatard et al. (2002) reported that concentrations of DHEA and cortisol non-athletes at rest, more athletes and exercise of DHEA causes significant changes, is not [8]. Hakkinen et al. (2000), no change in the cortisol response to resistance exercise, after a period of resistance training, were observed [9]. Kraemer et al. (1999) as well as high levels of testosterone in the subjects by RT reported [10]. Kraemer et al. (1999), also reduced the cortisol response to resistance exercise, after a period of resistance training, demonstrated [10]. McCall et al. (1999), after conducting its own research, the following resistance exercise reduces cortisol, were observed [11]. Fry et al. (1994), no change in the cortisol response to resistance exercise, after a period of resistance training, demonstrated [12].

In contrast, Staron et al. (1994) reported that serum cortisol response to acute resistance exercise with resistance training is reduced [13]. Kraemer et al. (1988) also reported that cortisol concentrations after resistance training is reduced [14]. Hakkinen et al. (1988) reported that subjects with RT indicated by elevated levels of testosterone [15]. Alen et al. (1988), the ratio of testosterone to cortisol increases during resistance training, were reported [16]. In contrast, Hakkinen et al. (1987), reducing the testosterone to cortisol ratio during resistance training, were reported [17]. Hakkinen et al. (1985) also increases testosterone and lower cortisol after strength training, were reported [18]. Staron et al. (1984) showed that intense heavy resistance training increases testosterone levels, is [19]. However, Weiss et al. (1983), increase testosterone and cortisol levels following resistance exercise, was reported [33]. DHEA concentration changes, and the nature of the DHEA, cortisol, in response to exercise, despite the limited research done in this area, are still unclear.

The aim of the present study was to determine the acute and chronic effects of resistance training interval, the levels of cortisol, DHEA, and the ratio of serum cortisol to DHEA, active young women.

MATERIALS AND METHODS

Subjects
The population for this study included all female students who were active in Tehran. 14 female student in Tehran from 20 to 25, mean age 22.571±1.804 years, height161.19± 4.094 cm, weight 56.904±6.533 kg, maximal oxygen uptake 38.428±1.567 milliliters per minute per kilogram of body weight, body mass index, and 21.879±1.999 kilograms by the square of height, which announced the recall of its readiness to participate in the study, the purpose, the for example, selected and randomly divided into two groups, consisting of a periodic RT group (n=7) and a control group (n=7), respectively. All subjects had a complete physical health (confirmed by a doctor).

Methods of data collection
One week before the study, at the briefing, participants practice and study protocols were introduced. At this meeting, in addition to familiarizing participants with the resistance movement, height, weight, body mass index, and maximal oxygen uptake and maximal strength (1RM), for each movement was measured. Then, 48 hours before the start of training, were present in the test session, immediately after and two hours after a single bout of resistance exercise period, blood samples were taken. The meeting with one maximum repetition rate of 20%, was convened. Then, subjects within 8 weeks of your exercise program increasingly conducted. Control group, did not do any exercise and just normal everyday activities, paid. After 8 weeks, followed by 48 hours of rest fits and starts

sampling interval of rest between training days (48 hours), the resistance exercise session, as well as the first day and with the same intensity of 20% one repeat maximum was performed. Before, immediately after and two hours after the session, blood samples were taken.

Training program

Resistance training, and increasingly includes 8 weeks and 3 days a week (every other day), respectively. Percentages of one repetition maximum speed and performance, as exercise intensity and volume of exercise were considered. Training volume, training intensity was kept constant and, increasingly rose. If the applied load was increased, the subjects during the 8 weeks of your exercise respectively 20%, 25%, 30%, 35%, 40%, 45%, 50% and 55% of one repetition maximum for eight weeks, they did. Resistance Training for circular and periodic manner, was designed. Each cycle consisted of bench press, leg press, biceps, front legs, back, arm, back, leg and lateral traction, that the performance was the same way. The time of each station, two minutes and thirty seconds was considered. Periodic training group, 10 seconds and 20 seconds at each station with its fast speed 2V and ½ V, alternatively, they run up to two minutes and thirty seconds to complete each station. Speed was controlled by a metronome. Interval of rest between each station and between the two circles, one minute, two minutes. In each session, two circles were considered. Resistance activities before and after the training period, a sampling test session was considered, as it were, with 20% of one repetition maximum. Control group, at this time, it did not do any exercise, and perform routine activities of there.

Blood sampling and hormone analysis

Before, immediately after and two hours after the first test (48 hours before the start of training), and final exam (48 hr after the end of practice), central venous blood samples from the subjects were collected at a rate of 5 cc. Control group at the beginning and end of 8 weeks (along with the experimental group) had blood samples. Samples were collected by centrifugation for 10 minutes at around 3500 RPM, the serum was separated from the plasma. All blood samples to be frozen at -20° C until the laboratory, were kept in the laboratory measurements began. Serum cortisol, for example, by using an ELISA kit from IBL with a sensitivity of 2.5 ng ml was measured. DHEA serum samples using ELISA kit from IBL with a sensitivity of 0.108 ng ml was measured. To convert cortisol unit, the formula ng / ml * 9.275 nmol / l and for the conversion of DHEA, the formula ng / ml * 3.47 = nmol / l, was used [21].

Statistical methods

The values of each variable in each sampling time, using the mean and standard deviation, were described. Then, to determine the normal distribution of the Smirnov tests - tests were used. To investigate the changes of variables in the training group, the ANOVA with repeated measures and LSD post hoc test was used. Also make sure the changes were not achieved in the control group, paired T-test was used for statistical software SPSS version 16, for statistical analysis, were used.

RESULTS

Table 1: Levels of cortisol, DHEA, and the ratio of serum cortisol to DHEA

Variables	Sampling Times	Training Groups	Control Groups
Cortisol (ng/ml)	Pre	102.37±18.99	94.2±14.803
	Post 1	90.16±11.728	
	Post 2	81.157±13.318	
	Post 3	73.857±12.605	92.342±12.022
	Post 4	68.214±12.721	
	Post 5	55.311±11.063	
DHEA (ng/ml)	Pre	3.172±0.181	3.107±0.561
	Post 1	3.288±0.526	
	Post 2	3.765±0.337	
	Post 3	4.091±0.437	3.41±0.39
	Post 4	4.572±0.517	
	Post 5	5.16±0.253	
DHEA to Cortisol Ratio (nmol/l)	Pre	4.031±0.887	4.229±0.955
	Post 1	4.696±1.113	
	Post 2	6.061±1.706	
	Post 3	7.25±2.13	4.729±0.916
	Post 4	8.759±2.389	
	Post 5	12.199±2.842	

Levels of cortisol, DHEA, and the ratio of serum cortisol to DHEA, are reported in Table 1. Values are the mean and standard deviation. Results of repeated measures ANOVA to examine cortisol, DHEA, and the ratio of DHEA to cortisol practice group, are presented in Table 2 and Table 3 Results of analysis of variance followed by LSD post hoc test measurements frequent shows. Table 4 shows the results of paired T-test of the control group reported changes, and Table 5 T-test results comparing the resting level training group and the control group, reported.

Table 2: Results of the statistical ANOVA with repeated measures for analysis of changes in practice

Group	Variables	Sum of Squares	df	Mean Squares	F	P
Training Groups	Cortisol	12419.17	1.286	9655.962	17.265	0.002 *
	DHEA	19.94	1.286	8.368	30.99	0.000 *
	DHEA to Cortisol Ratio	211.176	2.383	42.235	89.124	0.000 *

** The mean difference is significant at the 0.05 level*

Table 3: Results of LSD test after ANOVA with repeated measures for analysis of changes in practice

Comparison in timing of sampling	Cortisol	DHEA	DHEA to Cortisol Ratio
Pre - Post 1	P = 0.15	P = 0.42	P = 0.13
Pre - Post 2	P = 0.018 *	P = 0.005 *	P = 0.001 *
Pre - Post 3	P = 0.014 *	P = 0.000 *	P = 0.000 *
Pre - Post 4	P = 0.007 *	P = 0.000 *	P = 0.000 *
Pre - Post 5	P = 0.004 *	P = 0.000 *	P = 0.000 *
Post 1 - Post 2	P = 0.000 *	P = 0.004 *	P = 0.000 *
Post 1 - Post 3	P = 0.003 *	P = 0.000 *	P = 0.000 *
Post 1 - Post 4	P = 0.000 *	P = 0.000 *	P = 0.000 *
Post 1 - Post 5	P = 0.000 *	P = 0.000 *	P = 0.000 *
Post 2 - Post 3	P = 0.08	P = 0.059	P = 0.021 *
Post 2 - Post 4	P = 0.003 *	P = 0.018 *	P = 0.000 *
Post 2 - Post 5	P = 0.000 *	P = 0.028 *	P = 0.000 *
Post 3 - Post 4	P = 0.012 *	P = 0.017 *	P = 0.001 *
Post 3 - Post 5	P = 0.000 *	P = 0.022 *	P = 0.000 *
Post 4 - Post 5	P = 0.011 *	P = 0.068	P = 0.006 *

** The mean difference is significant at the 0.05 level*

Table 4: Statistical analysis of the paired T-test control group over 8 weeks

Variables	T	df	P
Cortisol	0.43	6	0.68
DHEA	1.34	6	0.22
DHEA to Cortisol Ratio	1.16	6	0.28

Table 5: T-test results were compared to the resting level variables in both groups

Variables	Time of Training	T	df	P
Cortisol	Before Training	0.89	12	0.38
	After Training	2.80	12	0.01 *
DHEA	Before Training	0.29	12	0.77
	After Training	3.07	12	0.01 *
DHEA to Cortisol Ratio	Before Training	0.40	12	0.69
	After Training	2.87	12	0.01 *

** The mean difference is significant at the 0.05 level*

Periodic serum cortisol levels in the RT group and during the study, significantly decreased (P=0.002). DHEA serum levels in the RT group and periodically during the course of the study, significantly increased (P=0.000). Furthermore, the ratio of serum cortisol to DHEA, periodic, and the period of study in the RT group, significantly increased (P=0.000). Also, significant changes in the variables studied in the present study, the control group was observed (P>0.05).

After 8 weeks, serum cortisol levels at rest, in practice, significantly lower than the control group (P=0.01). After 8 weeks, serum levels of DHEA resting in the training group, significantly higher than the control group (P=0.01). After 8 weeks, the ratio of serum cortisol to DHEA resting in the training group, significantly higher than the control group (P=0.01).

DISCUSSION

Based on the findings of the present study, serum cortisol levels in the RT group and during the study period, significantly decreased. Chatard et al. (2002) reported that non-athletes cortisol concentrations at rest, more athletes than in [8]. These results suggest that exercise reduces resting cortisol levels and also cortisol response to activity, decreases. Therefore resistance training reduces stress on the body caused by the activity, and be at rest. Nindl et al. (2001) stated that increased levels of cortisol, increased lipolysis and protein catabolism to fuel recovery and reconstruction after the activity was associated with [22]. In contrast to the findings Hakkinen et al. (2000), no change in the cortisol response to resistance exercise, after a period of resistance training, were observed [9]. However, Kraemer et al. (1999), reduced cortisol response to resistance exercise, after a period of resistance training, demonstrated [10]. Disagreement on these findings, it may be different exercise protocols or during exercise, may lie. Also, differences in the study population should not be ignored. Although Kraemer et al. (1999), 8 and 9 young 30 years old 62 years old were studied and observed that cortisol at 0, 3, 6 and 10 resistance training, no significant differences [10]. In any case, it appears that training reduces cortisol and reduced cortisol responses to the activity. However, contradictory findings are also seen in this area. McCall et al. (1999), after conducting its own research, the following resistance exercise reduces cortisol, were observed [11]. On the other hand, Folland and Williams (2007) also showed a significant acute increase in serum cortisol following a high volume resistance exercise with moderate to severe resistance and short rest periods between sets demonstrated [23]. Also, Staron et al. (1994) in line with the findings of the present study reported that serum cortisol response to acute resistance exercise with resistance training is reduced [24]. In a different study, Fry et al. (1994) did not alter the cortisol response to resistance exercise, after a show of resistance training [12]. The reason for the different results, it is not clear and requires further investigation, but Kraemer (1988) and Fry et al. (1994), separately stated, the acute response (due to work) and chronic (REST) as cortisol resistance exercise, however, is different, the exercise by the interaction of several variables (eg, intensity, volume, duration, rest periods, muscle mass involved) and individual characteristics (eg age, health and fitness) is determined [12,25]. Hakkinen et al. (1990) reported that, over a period of resistance training, has no effect on cortisol responses to resistance exercise [26] and Kraemer et al. (1988) also reported that cortisol concentrations after resistance training decreases [14]. In the present study, serum cortisol decreased during exercise was observed.

Details are still a lot of loose translucent variety of activities with cortisol responses to resistance there. Based on the findings of the present study, serum levels of DHEA, the RT group rotation, during the study period, significantly increased. Kvorning et al. (2006), increase testosterone and resistance training on strength development demonstrated [4]. Kraemer and Ratamess (2005) reported that heavy resistance training over several weeks or several months, some, but not chronic, cyclical changes in testosterone concentrations, can cause [27]. Willoughby and Taylor (2004), increased expression of androgen receptor in muscle cells to exercise, due to intense resistance training, were reported [28]. In contrast, and contrary to the findings, Chatard et al. (2002) reported that concentrations of DHEA non-athletes at rest, more athletes and the exercise will not result in significant changes DHEA [8] and Hakkinen et al. (2000), after a period of resistance training in epithelial after resistance exercise in men did not change [9]. However, Kraemer et al. (1999) High levels of testosterone in the subjects by RT reported. Those to changes in resting concentrations increased in response to acute exercise after a period of resistance training in men demonstrated [10].

Further investigation to determine the reason for the conflicting findings is necessary. However, following resistance exercise, expect to see the anabolic response cannot be simplistic. In this regard, Kadi (2000) stated that resistance training may increase the expression of the androgen receptor in muscle cells to exercise [29]. In terms of research, the results probably would not be the same. Training protocol may have an important role in the observed different plays. Raemer et al. (1992) reported that high-intensity strength training with enough volume to increase muscle mass and testosterone is [30]. In the present study confirm the findings, Hakkinen et al. (1988) reported that subjects with RT indicated by high levels of testosterone [15]. According to the study, the ratio of serum cortisol to DHEA, the RT group rotation, during the study period, significantly increased. Nindl et al. (2001) stated testosterone and cortisol levels, increased lipolysis and protein catabolism in fuel recovery and reconstruction after the activity was associated with [22]. In line with recent research findings, Alen et al. (1988), the ratio of testosterone to cortisol increases during resistance training, were reported [16]. Although Hakkinenet al. (1987), reducing the testosterone to cortisol ratio were reported during resistance exercise [17].

Clearly, much more remains to be done to evaluate the uncertainties on the sides. Perhaps the intensity and duration of exercise, especially strength training, the main influences are varied. Also, it is suggested that a similar study, exercise duration increase .

CONCLUSION

Active young women who are planning a program of resistance training, attempting to obtain benefits from their workouts, resistance training can use the periodic use. However, more research is needed, especially in the case of different types of resistance training, is.

REFERENCES

[1] Obminski Z, Stupnicki R., *J Sports Phys Fitness*. **1997**, 37(1): 50-55.
[2] Murray.R.K, Granner.D.K; Mayes.P.A. Rodwell.V.W., *Appleton and Lange. Bub.* **1993**, 23.
[3] Filaire E, Lac G., *Int J Sports Med*. **2000**, 21(1): 17-20.
[4] Kvorning T, Andersen M, Brixen K, Madsen K ., *Am J Physiol Endocrinol Metab*. **2006**, 291: E 1325-1332.
[5] Hakkinen A, Pakarinen A, Hannonen P, et al., *Clin Exp Rheumatol* . **2005**, 23(4): 505-512.
[6] Tremblay MS, Copeland JL, Van Helder W ., *J Appl Physiol*. **2004**, 96: 531-539.
[7] Willoughby DS, Taylor M, Taylor L ., *Med Sci Sports Exerc*. **2003**, 35:2023-2031.
[8] Chatard JC, Atlaoui D, Lac G, Duclos M, Hooper S, Mackinnon L., *Int J Sports Med.* **2002**, 23(7): 510-515.
[9] Hakkinen K, Pakarinen A, Kraemer WJ, Newton RU, and Alen M., *J Gerontol A Biol Sci Med Sci*.**2000**, 55: B95–B105.
[10] Kraemer WJ, Hakkinen K, Newton RU, Nindl BC, Volek JS, McCormick M, Gotshalk LA, Gordon SE, Fleck SJ, Campbell WW, Putukian M, Evans WJ., *J Appl Physiol*. **1999**, 87:982–992.
[11] McCall GE, Byrnes WC, Fleck SJ, Dickinson A, Kraemer WJ ., *Can J Appl Physiol*. **1999**, 24:96-107.
[12] Fry AC, Kraemer WJ, Stone MH, Warren BJ, Fleck SJ, Kearney JT, Gordon SE., *Can J Appl Physiol.* **1994**, 19: 400–410,.
[13] Staron RS, Karapondo DL, Kraemer WJ, Fry AC, Gordon SE, Falkel JE, Hagerman FC, Hikida RS ., *J Appl Physiol*. **1994**, 76:1247-1255.
[14] Kraemer WJ, Staron RS, Hagerman FC, Hikida RS, Fry AC, Gordon SE, Nindl BC, Gothshalk LA, Volek JS, Marx JO, Newton RU, Hakkinen K ., *Eur J Appl Physiol Occup Physiol*. **1988**, 78:69-76.
[15] Hakkinen K, Pakarinen A, Alen M, Kauhanen H, and Komi PV., *J Appl Physiol*. **1988**, 65: 2406–2412.
[16] Alen M, Pakarinen A, Hakkinen K, Komi PV., *Int J Sports Med*. **1988**, 9: 229–233.
[17] Hakkinen K, Pakarinen A, Alen M, Kauhanen H, Komi PV., *Int J Sports Med*. **1987**, 1(8): 61–65.
[10] Hakkinen K, Pakarinen A, Alen M, Komi PV., *Eur J Appl Physiol Occup Physiol*. **1985**, 53:287-293.
[19] Staron RS, RS Hikida, FC Hagerman, GA Dudly, R Murray., *J histochem cytochem.* **1984**, 32:146-152.
[20] Weiss LW, Cureton KJ, Thompson FN., *Eur J Appl Physiol Occup Physiol.* **1983**, 50: 413–419.
[21] *http://www.unc.edu/rowlett/units/scales/clinical_data.html*
[22] Nindl BC, Kraemer WJ, Deaver DR, Peters JL, Marx JO, Heckman JT, Loomis GA., *J Appl* Physiol. **2001**, 91: 1251–1258.
[23] Folland JP, Williams AG., *Sports Med.* **2007**, 37:145-168.
[24] Staron RS, Karapondo DL, Kraemer WJ, Fry AC, Gordon SE, Falkel JE, Hagerman FC, Hikida RS ., *J Appl Physiol*. **1994**, 76:1247-1255.
[25] Kraemer,W. J., *Med. Sci. Sports Exercise.* **1988**, 5(20): S152–S157.
[26] Hakkinen K, Pakarinen A, Kyrolainen H, Cheng S, Kim DH, Komi PV., *Int J Sports Med*. **1990**, 11:91-98.
[27] Kraemer WJ, Ratamess NA ., *Sport Med*. **2005**, 35:339-361.
[28] Willoughby DS, Taylor L ., *Med Sci Sports Exerc*. **2004**, 36: 1499-1506.
[29] Kadi F., *Acta Physiol Scand Suppl*. **2000**, 646:1-52.
[30] Raemer WJ, AC Fry, BJ Wwarren, MH Stone, SJ Fleck, JT Kearney, BP Conroy, CM Maresh, CA Weseman, NT Triplet, SE Gordon., *Int. J Sports Med*. **1992**, 13:103-109.