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The effect of 8 weeks of plyometric training on cortisol and DHEA Levels in male badminton players

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ABSTRACT

The portion of anabolic to catabolic hormones concentration is one of the most important physiological factors of exercise effectiveness and is one of overtraining symptoms. The purpose of the present study was to investigate the effect of 8 weeks of plyometric training on levels of Cortisol, DHEA and DHEA/C ratio in male badminton players. Subjects were 20 Badminton Players (age 15-18) who participated is the study voluntarily and were randomly assigned in plyometric (n=10) and control (n=10) groups. The plyometric group performed eight weeks of selected plyometric training along with a normal badminton training program, and control group just performed normal badminton training. Cortisol blood sample, DHEA and DHEA/C ratio Levels were measured before and after twelve weeks. Both groups' data was analyzed using paired t-test and independent t-test statistical methods. Within-group comparison results showed statistically significant differences in cortisol levels (p=0.001), DHEA (p=0.008) and the ratio of DHEA/C (p=0.003) in the plyometric group. Also between-group variable comparisons showed significant differences in cortisol levels (p=0.026), DHEA (p=0.020) and the ratio of DHEA/C (p=0.004) after eight weeks of training. Findings showed that plyometric training reduces cortisol levels as a catabolic indicator and increases DHEA as an anabolic indicator.

Keywords: Cortisol, DHEA, DHEA/C ratio, Plyometric Training, Adolescent, Badminton.

INTRODUCTION

Hormones change in response to exercise training. Exercise training acts as a stress factors to the endocrine system, and causes conspicuous changes in hormonal concentration [1,2].

Cortisol is released from the cortex of the adrenal gland in response to stress, results in protein synthesis and decreased synthesis in muscular cells, and is able to stimulate lipolysis of fat cells. Cortisol is the major glucocorticoid in humans, and is a catabolic hormone released in response to physiological and psychological stress. Cortisol is released by adrenocorticotropic which itself is released from the pituitary gland [3-5]. Increased cortisol has modulatory effects on the immune system. Studies show that intense exercise training increases cortisol levels. Therefore investigating cortisol levels is a common method for understanding the physiological effects of exercise in humans [1,6].

DHEA is a Multi-functional steroid creating a wide range of biological effects in humans and other mammals.it is the most abundant steroid hormone in humans synthesized by adrenal gland, and has an anabolic effect on several tissues by changing into sex steroids, including testosterone and estrogen. Nearly 90% of circulating testosterone is synthesized from DHEA. Changes in DHEA and cortisol are dependent on intensity, duration and environmental conditions of exercise [7,8]. DHEA secretion starts in pre-pubertal period, its maximum amount of secretion occurs in the age of 25-35 years and declines steadily with increasing age to the lowest amount [9].

Both Cortisol and DHEA are synthesized in adrenal cortex and it is conceivable that the DHEA/C ratio is influenced by of adrenal output due to biological factors [10]. DHEA/C ratio is used as a marker of training stress in athletes. This ratio is influenced by intensity and duration of exercise training, and any change in this ratio can be associated with a change in functions of immune system. When athletes are at great pressures, some hormonal changes occur with the most outstanding ones in anabolic-catabolic hormones. Balance between catabolic hormones such as cortisol and anabolic ones like DHEA has important applications in training and sports competitions [7,8].

Plyometric exercise is one of the most effective training methods for athletes improving performance, agility, vertical jump performance and muscle strength. Few athletes can be found who never normally used plyometric exercises to develop their speed, strength, and power [11,12]. Coaches and athletes claim that plyometric training will create a link between power and strength and directly enhances competitive performance. Compared with traditional training, plyometric training can be helpful to achieve the highest level of performance [13-15].

Strength and muscular power are considered as important factors in competitive sports for athletes. Muscle strength and power are necessary for some training performances such as jumping and accelerated rapid movements. Badminton needs rackets and is a non-contact sport which requires a wide range of body movements such as jumping, direction change and rapid movements. Badminton can be considered as an alternating sport marked by a combination of short- period high and low intensity movements [16,17].

In last decades a number of researches investigated the endocrine system's response to exercise and observed a lot of changes in levels of hormones. However, many studies examined adults' hormonal responses and less research has been done on adolescents [2]. So in present study the effect of 8 weeks of plyometric training on cortisol, DHEA levels, and DHEA/C ratio were studied in male adolescent badminton players.

MATERIALS AND METHODS

Subjects of this study were 20 adolescent male volunteers aged 15-18 years old. They were selected according to their age, health and badminton training experience. Subjects' characteristics are presented in Table 1. Objectives, details and implementation risks were described to the participants, and then the participants and their parents who voluntarily participated in the study completed questionnaire and physical health consent. Qualified individuals were randomly assigned in plyometric (n=10) and control (n=10) groups. Plyometric training program is presented in Table 2.

Table 1- Participant Characteristics

Parameter	Plyometric training	Control group
Age (year)	17.10±1.72	17.00±1.41
Height (cm)	164.20±9.85	162.90±7.64
Body weight (kg)	54.40±7.64	52.90±8.37
Body Mass Index (kg/m2)	19.84±2.29	19.90±2.44

Table 2- Plyometric training program

Week / Training	1-2	3-4	5-6	7-8
Running gait with both feet	1 rep	2 rep	3 rep	4 rep
Foot switch leap upward	15 rep	20 rep	30 rep	40 rep
Jump on 8 cones Side	2 set	3 set	4 set	5 set
Jump from the cone 8 directions	2 set×30sec	2 set×40sec	2 set×50sec	2 set×60sec
Medicine Ball Move the ball up and down and vice versa	30 sec	40 sec	60 sec	75 sec
Medicine Ball wing throwing the ball forward with both hands from behind.	30 thr	40 thr	50 thr	60 thr
Medicine Ball throws the ball down the wing upward with both hands	30 thr	40 thr	50 thr	60 thr

rep: repetition, sec: second, Thr: throw

Measurement of study variables

A week before the main test, subjects' height, weight, and body mass index were measured in both groups at the preliminary session. Both groups pre-test initial sampling was conducted at eight o'clock in the morning. Subject's in plyometric group performed plyometric exercise training sessions for 30 minutes in two days a week (Monday and Wednesday) during eight weeks. These participants performed normal badminton exercises three days a week (Sunday, Tuesday and Thursday) while subjects in control group just performed badminton exercises three days a week and did not perform eight weeks plyometric exercises. One day after exercise training program, second blood samples were collected from both groups. Subjects' weight were measured by Beurer digital scale, JS model, made in Germany, and their height were measured by Mabis model tape, made in Japan. Cortisol was measured by

Monobind Company Kate, model number (eia-36 kb 2) made in U.S.A, and DHEA by Monobind Company Kate, model number (eia-51k2a2) made in U.S.A.

Statistical Methods

Statistical analysis was performed using SPSS version 18. Data normality was investigated using Kolmogorov – Smirnov test. Paired t-test was used for within- group comparison and independent t-test was used for between-groups comparison. The significance level of the test was considered $p \leq 0.05$.

RESULTS

Within group variables comparison is presented in table 3. Results showed a decrease in cortisol levels(p=0.001), an increase in DHEA levels (p=0.008) and a significant increase in DHEA/C ratio (p=0.003) in plyometric training group in post-test compared to pre-test; however, no Significant changes were observed in research variables in control group after eight weeks. Table 4 reports the comparison between measured means of plyometric and control groups. The results showed significant differences in cortisol and DHEA levels and DHEA/C ratio between the two groups (p=0.026, p=0.020 and p=0.004, respectively).

Table 3. Comparison of before (pre) and after (post) Intervention Values of Measured Variables

Parameter	Phase	Plyometric training	P value	Control group	P value
Cortisol (µg/dl)	Per	13.06±2.26	0.001	11.82±2.82	NS
	post	8.84±1.86		11.73±3.27	
DHEA (µg/dl)	Per	1.29±1.02	0.008	1.63±0.94	NS
	post	2.70±1.09		1.68±0.74	
DHEA/Cortisol ratio (µg/dl)	Per	0.100±0.078	0.003	0.140±0.079	NS
	post	0.336±0.161		0.148±0.075	

Table 4. Comparison of Changes in Measured Variables during 8 Week in Two Groups (Means±Sd)

Parameter	Plyometric training	Control group	P value
Cortisol (µg/dl)	8.84±1.86	11.73±3.27	0.026
DHEA (µg/dl)	2.70±1.00	1.68±0.74	0.020
DHEA/C ratio (µg/dl)	0.336±0.161	0.148±0.075	0.004

DISCUSSION

The present study was designed to investigate the effect of 8 weeks of plyometric training on cortisol, DHEA, DHEA/C ratio levels in male badminton players. Research findings showed that cortisol levels reduced at post-test compared to pre-test in plyometric group and this reduction was statistically significant. Also no significant differences were observed in cortisol levels in control group at post-test compared to pre-test. Khaledan et al (2002) in a study investigated the effect of strength and endurance training programs on cortisol levels in young male athletes. A significant decrease in cortisol levels was observed [18]. These results are consistent with those of plyometric group, but are inconsistent with the results observed in control group. Usui et al (2011) in a study investigated the effects of prolonged strenuous exercise on cortisol levels in young men and observed a significant increase [19]. These results are inconsistent with those obtained from plyometric group but are consistent with the results obtained from the control group. Cortisol hormone is one of the most important hormones and indicators of stress and is released from cortical portion of adrenal gland in response to the pressures on physical and psychological mechanisms and strengthens the effect of catecholamine. One of the most important factors that trigger the secretion of this hormone is strenuous physical activity and its alterations depend on exercise intensity and duration and type of nutrition [20]. Exercise is known as a strong stimulator of the endocrine system. Hormonal sensitivity to exercise depends on several factors, including intensity, duration, and type of exercise and how to train people [21]. Probably intensity, duration, type of training program and type of subjects' training in this research resulted in reduced serum cortisol. Plyometric exercises were more severe than ordinary exercises. So it was expected that high-intensity exercises increase cortisol levels and subsequently result in increased catabolism process in muscles to provide immediate body requirements. Perhaps the importance of subjects' adaptation can be mentioned as one of the main reasons to justify results obtained during eight weeks. Also given that the control group just participated in normal badminton exercises and the intensity of these exercises was not controlled probably this factor did not cause cortisol levels to be so much affected.

Research findings showed that DHEA levels in plyometric group increased significantly at post-test compared to pre-test. Also in control group no significant differences were observed in DHEA levels at post-test compared to pre-test. Jassim et al (2010) in a study investigated the effects of moderate intensity exercises on DHEA levels in young men and observed significant increase in DHEA levels [22]. These results are consistent with previous results

observed in plyometric group, but are inconsistent with results observed in the control group. Ebrahimpur et al (2010) in a study investigated the DHEA and saliva cortisol changes in girl volleyball players and did not observe significant differences in DHEA values [23]. These results are inconsistent with those obtained from plyometric group and are consistent with results obtained from control group. Sex hormones affect sexual growth and maturation especially during adolescence, and cause the growth of secondary sexual traces and sexual organs [24]. DHEA is linked to testosterone and estrogen chemically. This hormone is synthesized from cholesterol by adrenal glands [25]. Probably increase in this hormone triggered testosterone synthesis in plyometric group subjects and put its anabolic effects on some tissues. It can be a factor improving body composition and exercise performance. But in control group subjects exercises probably were not able to stimulate adrenal glands to release DHEA, so no significant change were observed in these subjects.

Research findings showed that DHEA/C ratio in plyometric group increased significantly at post-test compared to pre-test. Also in control group no significant differences were observed in DHEA/C ratio at post-test compared to pre-test. Yazdanparast et al (2011) investigated the effect of exercises with different intensities on DHEA/C ratio. No significant differences were observed in DHEA/C ratio in these subjects [8]. These results are consistent with previous results of plyometric group, but are inconsistent with results observed in control group. Farzanegi et al (2010) examined the effects of competitive stress on DHEA/C ratio values in young girl handball players, and did not observe significant changes in DHEA/C ratio values [26]. These results are inconsistent with those obtained from plyometric group and correspond with the results of control group. DHEA/C ratio is used as a marker of training pressure in athletes. This ratio is influenced by exercise intensity and duration. When athletes are at great pressures, some hormonal changes occur with the most outstanding ones in anabolic-catabolic hormones [7,8]. Given that DHEA/C ratio is used as an indicator of exercise pressure it can be concluded that plyometric exercises with such intensity and duration affect this ratio favorably. Regular badminton exercises did not disturb the balance between catabolic cortisol and anabolic DHEA hormones. The results of this study showed that normal badminton exercises, accompanied by plyometric exercises can have favorable effects on the balance between anabolic and catabolic hormones.

CONCLUSION

Limitations of this study include the lack of control on subject's genetic factors, weight, BMI, nutrition, sleep and psychological states. The findings showed that plyometric training can reduce cortisol levels as an indicator of catabolic and can increase DHEA as an indicator of anabolic hormones. Therefore, it is recommended that young athletes perform plyometric exercises as a supplement to the exercises of their own specialized fields.

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