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Investigate the effect changes of volume and intensity training on level salivary cortisol in elite girl badminton players

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ABSTRACT

The aim of this study was to investigate the effect changes of volume and intensity training on level salivary cortisol in elite girl Badminton players. In order to this purpose, 22 elite girl badminton players were chosen and put in 2 groups of variation of volume and intensity of training . Practicing program of group of training volume variations was designed based on number of sessions, duration of practice and the second group was based on percentage of maximum heart rate. Vo2max and agility tests were done in order to measure player's performance. Profile of mood states (POMS) questionnaire in order to salivary cortisol sampling for measuring the concentration of salivary cortisol were carried out in 5 steps between 8 to 11am(before beginning of practicing program, at the end of 2nd, 4th,6th and 8th weeks). The results of this study showed that changes in volume and intensity of training have not significant effect on salivary cortisol concentration in girl badminton players. According to the results of this study, It suggest that given to dependence of physiological changes specially hormonal changes on volume and intensity of training, the coaches considered on determining rhythm and trend of volume and intensity of training

Key words: Volume of training, intensity of training, salivary Cortisol

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INTRODUCTION

*The concept of training is highly specialized that is known as a pre*ssure process in some specific situation and also affect on physiological and psychological factors[1, 2]. The purpose of trainings is enhancing and strengthening performance. However, high intensity trainings cause to overtraining, whereas low intensity trainings resulted to poor performance. Overtraining syndrome represents the volume and intensity of training and inadequate rest time and also the inability to doing training[3]. Given to the nature of Badminton that is consisted of game time, type of rally, speed and rapid movements, the need to both aerobic and anaerobic systems is necessity. By strengthening anaerobic system the acidification of blood during the training is prevented and as a result it prevents of disorders in power level, conscious, concentration and body strength decreasing. Although, strengthening anaerobic system cause to stability in athlete performance during the training, it has significant effect on heart rate recovery and muscles both during and after the exercise[4, 5].

On the other hand, the total of hormonal responses to training could be divided to expectancy stages, exercise beginning, adaptation, fatigue and recovery. It seems that at every stage hormone secretions is different and it

change based on intensity of stage[6, 7]. Adrenal Cortical hormone (i.e, cortisol) response to exercise is unusual and different[4]. Some researches revealed that there is significant variability in cortisol response to exercise, which in turn it is based on factors such as duration and intensity of training, athlete's physical conditioning, quality of food and the rhythm of secretion during the day[8, 9].

Researchers found that these changes may be a function of the intensity, duration and type of exercise program. Recent studies have found that sudden increase in training volume and intensity, monotonousness of training and psychological problems is the main causes of overtraining that increase of salivary cortisol levels is one of the it's biochemical symptoms. Although, decreased performance and increase of recovery period could be referred as an overtraining symptoms[10].

Mc Guigan et al (2004) showed that physical activity with different intensity make different responses in salivary cortisol concentration. In high intensity physical activity (%75 maximal strength) the concentration of salivary cortisol is increased but there was not significant variability on salivary cortisol concentration in low intensity physical activity (significant differences %145 between high and low intensity,[11].

Maximal plasma cortisol levels after prolonged exercise (the runners) have been observed. If the exercise period is long enough, even in low load activity (light) cortisol level is increases. The importance of exercise duration as a factor influencing on cortisol response was provided by Boonen[3].

Physical activities and exercises result to increase or decrease of some hormones such as catecholamine's, growth hormone and steroids especially cortisol in compared with resting rate. This fact that the hormones make response to sport activity is very important[12, 13]. The testosterone and cortisol considered as major catabolic and anabolic hormones in the body and those responses to exercise may differ[14]. Cortisol secretion does not follow a uniform flow and constant and has a circadian rhythm, so that the secretion reaches to maximum rate in the early hours of the day but with begins of the day it decline, thus by experiencing any type of stress the circadian rhythm will disrupt [3].

When exercise is performed, regardless of strength or aerobic exercise, cortisol is released in proportion to the intensity of training. Cortisol increases changes muscle fuel to fatty acids and amino acids and limited the entry of glucose into skeletal muscles and in order to increase glucose production provide fuels such as amino acids to liver[15, 16].

Boget et al (2006) found that the recovery and hormonal parameters among 12 female cyclists have significant relationship with training volume and salivary cortisol increasing and also stress levels. They reported that increasing the training volume, increased salivary cortisol and this change has been observed after four days of high intensity training. This increase were represents of the presence of stress and mood disorders and they believed that presence of stress in trainings has significant relationship between psychology and hormonal change such as making response to stress and also have valid evidence to do researches in regard to variability of training type and athlete females hormones[17]. Mc Guigan et al (2004) study on 20 athletes (10 men and 10 women) with strength training indicates that there was significant increasing on salivary cortisol after three session of strength training during the week. On the other hand, they observed that in the strength sports such as weight lifting cortisol rate increase more than training duration[11].

Maso et al (2004) conducted one study on 25 rugby players in order to measure the levels of cortisol and testosterone in a 15 -hour training program in a week that this program was consisted of aerobic trainings, high intensity interval lactic acid and finally a game. Given that the syndromes of overtraining have been observed, they found that the athletes cortisol rate increased after these trainings, but during overtraining this increase don't observe[3].

Golzalez et al (2002), in the other research, conducted one study on 20 male basketball players during 4 month and they report that the trainings that were based on the training volume, no significant changes in mood and cortisol were have been observed. Cortisol is sensitive only to the volume and intensity of training. Correlation between cortisol and training volume indicate that decrease in cortisol occurs when training was intense and when increased training time is less[10].

Generally, the main purpose of physical exercises is to improve athletic performance, regardless of sport type and performance level, the training must be regular and relevant to sport. Therefore, it is necessary to athletes that have regular and specific trainings with low and high volume and intensity and also along with recovey periods. Because athletes adaptation and performance improvement is based on quantitative (volume) and qualitative (intensity) of training, therefore, in order to have better understanding about athletes identifying these changes by coaches is very important. Finally, it is related to coaches' skills that designed the relevant and effective training programs according to the athletes' physiological capacity and also determined appropriate recovery periods.

In this regard, the main goal of coaches is to develop players' physical performance. To develop these abilities training conditions must be change constantly until positive adaptations in athletes occur and then athletic performance improves that the most important component of training is volume and intensity. The result of this study could helps coaches and athletes to improve performance through selection and regulate appropriate training program. In spite of the studies done on the hormonal response to physical activity, yet it is not clear which component of the exercise intensity (intensity or volume) is critical? Therefore, the results of this study may be providing some information about effect and efficacy of changes volume and intensity training on level salivary cortisol.

MATERIALS AND METHODS

This semi-experimental two-group study was approved by the Ethical and Research Committee of the University of Kharazmi and performed in accordance with the principles outlined in the Declaration of Helsinki.

Subjects

The population of this study was 80 players participating in Tehran Badminton League that each of them had at least one year participating in official badminton competitive and regularly in at club level activity. The 24 participants were selected through simple random sampling with replacement, but 2 athletes eliminated due to the absence in all test stages and finally 22 girl badminton players were selected and as a statistical sample . Through questionnaire and interview it identified subjects have no patient history and no drug use, they also have good health and had normal menstrual. The participants' general characteristics are given in Table 1.

TABLE 1. GENERAL CHARACTERISTICS OF THE SUBJECTS (mean± standard deviation)

Group Variable	1 Experimental group (training intensity changes) **(N=11)**	2 Experimental group (training volume changes) **(N=11)**	F	P
Age (year)	20.2±2.81	21.08±3.6	5.412	0.657
Weight (kg)	59.8±5.22	57.67±5.16	6.328	0.842
Height (cm)	169.0±6.56	168.5±8.43	5.245	0.724
VO_{2max} (ml.kg/min)	66.54±0.94	66.70±0.81	1.789	0.518

Measure of physical performance indices

Trainings were designed in three stages: increases the initial practice, stop and increases secondary practice. Changes in training volume were designed based on the number of sessions and duration of each exercise session. In the first week, subjects exercised for 535 minutes with low intensity during 5 sessions, in the second week, subjects exercised for 669 minutes with low intensity during 6 sessions, in the third week subjects exercised for 820 minutes with average intensity during 7 sessions, in the fourth week, subjects exercised for 952 minutes with average intensity during 8 sessions, in the fifth and sixtieth week training stopped, in the seventh week, subjects exercised for 1083 minutes with low intensity during 9 sessions and in the eighth week, subjects exercised for 1174 minutes with low intensity during 10 sessions.

The method of training based on changes in training intensity

Trainings were designed in three stages: increases the initial practice, stop and increases secondary practice. Intensity changes were implemented based on a percentage of maximum heart rate. In the first week, subjects exercised for 1122 minutes with low intensity during 10 sessions, in the second week, subjects exercised for 1060 minutes with average intensity during 9 sessions, in the third week, subjects exercised for 1001 minutes with high intensity during 8 sessions, in the fourth week, subjects exercised for 920 minutes with very high intensity during 7 sessions, in the fifth and sixtieth week training stopped, in the seventh week, subjects exercised for 886 minutes with

high intensity during 6 sessions and in the eighth week, subjects exercised for 820 minutes with low intensity during 5 sessions.

Salivary collection

To measure salivary cortisol samples 5 minutes before and after the start of each test through 5 stages include before of training in first day, last day of training in 2,4,6 and 8 weeks were collected:

At first, to prevent dehydration subjects drank 200 ml of water and after a few minutes, rinse their mouth and pour 4 ml of their non-stimulated saliva into tubes specifice for sample collection. The collected samples initially placed in the chamber containing ice and then were frozen at minus 20 ° C, after collection of all samples to be tested. Given that of cortisol secretion is the circadian rhythm; all samples were collected between 8 to 11 A.M. Also, to reduce the detrimental effects, salivary sampling was taken at the same location and condition.

Hormonal measuring

Salivary cortisol concentration was determined by using Kat EIA made in Germany through ELISA and based on the manufacturer's instructions.

Statistical methods

Statistical analysis of the data was performed for each group using the means and standard deviations. Then, the Kolmogorov-Smirnov test was used to ensure that the data were normally distributed. Student's t test was used to perform the between-group analysis of variance with repeated measures. ANOVA[3] was used for within-group evaluation along with the Greenhouse-Giser (GG) correction. The t-test with the Bonferroni correction was used to identify significant differences by determining the difference location to reduce the error for paired samples. The significance level was $P \leq 0.05$ for all the calculations, and all statistical tests were conducted using SPSS software (version 18, Michigan, USA).

RESULTS

According to this study findings, the maximum change in salivary cortisol concentration due to training intensity changes were in elite girl badminton players at fourth week (3/9 ng/ml) and minimum change was (0/9 ng/ml) at eighth week (table 2). Whereas due to training volume changes maximum salivary cortisol concentration (-6 ng/ml) was at sixth week and minimum changes was at fourth week (tabel 2). Generally, due to training maximum change in salivary cortisol concentration was at eighth week (-3/95 ng/ml) and minimum changes was at fourth week (-1/ ng/ml). In table 2 the mean salivary cortisol concentration changes in elite girl badminton players has been shown. The results of variance indicated that, also, training intensity changes (F4, 36=1/183, p>0/05) and training volume (F4, 36=1/96, p>0/05) haven't significant differences on girl badminton players salivary cortisol changes.

TABLE 2. Changes level of salivary cortisol in 1 and 2 Experimental groups (mean± standard deviation)

Variable	Groups		(week 1)	(week 2)	(week 4)	(week 6)	(week 8)
salivary cortisol (ng/ml)	1 Experimental group (training intensity changes) (N=11)	Pre -training	23.3±2.1	26.9±3.1	26.6±4.5	27.4±4.4	33.1±7.1
		Post-training	25.9±4.5	29.6±3.6	30.5±2.9	29.2±5.6	32.2±4.9
	2 Experimental group (training volume changes) (N=11)	Pre -training	26.4±3.4	24.7±3.4	24.9±4.4	23.0±3.7	29.1±2.5
		Post-training	28.9±3.5	26.5±1.2	24.1±2.5	29.1±4.5	32.6±3.9

DISCUSION

The results of this study showed that changes in exercise intensity have not significant effect on salivary cortisol concentration in girl badminton players. Maximum change was in salivary cortisol concentration at fourth week and minimum change was at eighth week and training volume changes haven't significant effect on salivary cortisol in girl badminton players. Maximum change was at sixth week and the minimum change was at fourth week, also there were not significant differences between two training methods on salivary cortisol concentration in girl badminton players. Generally, due to training maximum change in salivary cortisol concentration was at eighth week and minimum change was at fourth week. This study showed that due to high intensity training the maximum changes in salivary cortisol concentration (concentration decrease) were at the fourth week.

Rahman and et al (2010) study on 10 active men through Bruce protocol treadmill test showed that salivary cortisol and TNF-α Increased and the maximum increase occurred at 14 minutes and then decreased in intense exercise[18]. Boget and et al (2006) indicated that increasing training intensity especially after the fourth session result to increasing of salivary cortisol concentration. The result of this study is consistent with Rahman and et al (2010) and Boget and et al (2006) findings. Boget and et al (2006) suggest that daily training should be making stress as a competition[17].

Roschel and et al (2011) found that strength training with vibration protocol has not significant effect on salivary cortisol[19]. Hayes and et al (2013) examined, also, the effect of 6 week aerobic exercise on ability improvement, body composition and salivary cortisol profiles in older people. They report that salivary cortisol concentration on inactive old peoples after training have not significant differences [20]. Thus, group with training changes at volume, maximum changes were occurred at fourth week due to increase of training volume and after it high decrease was observed. Despite differences in salivary cortisol concentration changes in the volume and intensity of exercise the difference was not statistically significant. Crewther and et al (2008) suggest that the increase in cortisol concentration is associated with general volume of strength exercise (eg, number of sets and external load)[21].

Golzalez et al (2002) study on 20 male basketball players indicates that salivary cortisol concentration decrease is associated with increase of training volume and intensity and also depression. This result indicates that even after four months, the training could not make hormonal and mood adaptation. The duration and pressure of training might be possible reason of this inconsistent. The catabolic metabolism could also be the other reason of cortisol sensitivity to adaptation in training, thus the type of sport, team or individual and gender can be an important reason. In this study, elite athletes experience limited changes on mood in basketball trainings more than non elite[10].

Mc Guigan et al (2004) reported salivary cortisol concentration increase due to training intensity changes and suggested that salivary cortisol significantly increases with increase of volume and intensity of strength training[11].

CUNCLUSION

With regard to results of this study that further studies are needed to conduct. It suggest that given to dependence of physiological changes specially hormonal changes on volume and intensity of training, the coaches considered on determining rhythm and trend of volume and intensity of training. Coaches training about the importance and impact of physiological changes on athletes' performance can be placed on sport federations. It is recommended that coaches in planning training predict appropriate recovery periods to athletes in order to more adaptation with training volume and intensity changes. Given to individualistic nature of badminton and also effect of personal characteristics especially psychological factors on performance, it is recommended that coaches in planning trainings use the combination of volume and intensity.

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