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The Effect of Win or Loss on Serum Testosterone and Cortisol Hormones in Female Basketball Players

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Abstract: The aim of the present study was to investigate the effect of an official basketball game and its outcome on serum testosterone and cortisol responses. For this purpose, two teams were purposefully selected from semi-final games of Tehran first clubs. The blood samples of 22 female players (mean age: 20 years, mean testosterone at rest: 0.507 ng/ml, mean cortisol at rest: 96.143 ng/ml) were gathered two hours before and 15 minutes after the game. The time each player actively participated in the game was recorded for each team separately and the collected data were analyzed by dependent and independent t tests. The results showed a significant increase in testosterone and cortisol of fixed players of both teams who actively played in 70% of the official basketball game ($p<0.05$). There was no relationship between the changes of testosterone and cortisol during the game and win and loss ($p>0.05$). It can be concluded that an official basketball game with mental and physical challenges can dramatically increase testosterone hormones with strong anabolic effects and serum cortisol with catabolic effects in female players.

Key words: Basketball female players % Win and loss % Serum testosterone and cortisol

INTRODUCTION

Sport games affect hormonal responses with respect to the game outcome (i.e. win or loss). The relationship between testosterone and cortisol with sport competitions in males has been vastly studied while there are few studies of female athletes. Data collected in recent decades show that different physiological and psychological factors affect the responses of those nerve cells which make hormones to competitive encounters. The difference in age and gender, physical fitness, body mass, type of activity, the importance of competition, the time each player participates in the game and the role each player plays in win or loss in a competition results in different hormonal changes [1-10]. One method to directly assess the effect of testosterone on self-confidence is to compare the behaviors of those subjects who had received different hormonal doses. However, with respect to ethical and practical barriers to different testosterone doses in healthy subjects, studies are directed towards this issue: can a change in conditions change the natural production of testosterone? One of those conditions which can naturally change testosterone responses is physical activity [2].

Regarding Mazur's biosocial status hypothesis [11-13], there is a direct relationship between the testosterone level and player's competing for status and victory leads to increase in or maintenance of this hormone in future encounters. Although the main weight of the hypothesis falls on testosterone, reference was also made to cortisol and subjective experiences (effort, discomfort, anxiety).

In a study, a real match between two professional basketball teams (male players) in Spain league was investigated. Results did not show statistically significant different T and C salivary responses depending on the outcome while T response correlated positively with the "score/time playing" ratio, an indicator of individual participation in the outcome. Negative mood was significantly enhanced, especially in the losers. In a study of tennis players, victory in winners significantly enhanced T and defeat in losers significantly enhanced C after the match [2, 13]. The changes of the above hormones were considerable in martial arts such as judo and karate. In such activities, physical discipline results in the effective mental control of the athletes and T response to competition is opposite in other sport fields. In martial arts, a future

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winner experiences a slight increase in T due to lower arousal and higher mental control while losers experience higher T level [8].

On the other hand, women produce five to seven times less testosterone than men [1]. While activation of the hypothalamic-pituitary-gonadal axis is the primary source for testosterone in men, in women the majority of testosterone is derived from the peripheral metabolism of dehydroepiandrosterone (DHEA). DHEA is secreted by the adrenal gland in response to activation of the HPA axis in reaction to challenging or threatening events and is associated with changes in cortisol. If HPA activation and subsequent release of DHEA are linked to increases in women's testosterone levels, it is biologically plausible to believe that women have a different pattern of relationships among testosterone, cortisol and competition than do men [1].

Indeed, active participation in the competition is not necessarily required to change the level of these hormones; these changes also occur in nonphysical competition such as chess matches: some studies reported that there was no relationship between T changes and outcome; they also reported a significant relationship between winning and increased T and positive mood. Also, testosterone levels increase among spectators watching their favorite sports teams win and decrease for fans of the losing teams [1]. In a study of men and women from a southern university's intercollegiate varsity soccer teams, an increase in salivary T and C after the match as well as a significant increase in C in reserved players have been reported [5]. Cortisol may play a role in behaviors important in competition, including aggression, arousal and mobilization of physiological resources to deal with impending threat or challenge [1].

Taylor *et al*., (2000) stated that men are more likely to fight-or-flight in stress situations whereas women are more likely to tend-and-befriend [14]. In the above studies, the role of T and C in male competitors has attracted the attention of gland doctors [15]. The results of individual sport games such as tennis, wrestling, judo and chess were compared with those of team games such as rugby, football and handball [8, 16-24] while there are few studies of physiological changes and hormonal level in female athletes [25].

The role of T and C as an anabolic-catabolic index in performance on one hand [26-30] and the nature of a basketball game as a power sport field and its effect on athletes' physiological changes on the other hand are of utmost importance. As basketball requires aggressiveness, involvement, sprints, jumps, agility [22, 31] and high physical fitness, it is essential to investigate the probable changes in T and C hormones depending on the outcome in Iranian female basketball players in two or three consecutive games per week (in match season).

MATERIALS AND METHODS

In this quasi-experimental study, the effect of an independent variable (an official basketball game) on dependent variables (serum testosterone and cortisol, serum T:C) was studied. The statistical population consisted of two teams out of 12 teams in female basketball semi-final games of Tehran first clubs. Two teams whose competition was very important (mean age: 20 years, mean testosterone at rest: 0.507 ng/ml, mean cortisol at rest: 96.143 ng/ml) were purposefully selected as the sample of the study. The subjects were examined to ascertain that they did not consume any drugs or supplements.

Data Collection: The blood samples were gathered two hours before and 15 minutes after the game. Seven players of each team (total N=14) who actively played in 70% of the official basketball game were selected and investigated as the sample. It should be mentioned that the coaches of both teams changed the players during the game while they did not consider the time the players actively participated in the game. T and C changes were measured by ELISA method using IBL testosterone and cortisol kits (made in Germany).

Data Analysis: Kolmogorov-Smirnov test was to examine the homogeneity of the obtained data. Paired sample t test was used to study the effect of the basketball game on T and C changes and their ratio in the fixed players of both teams before and after the game. Independent t test was used to investigate the role of winning and losing in changes of these hormones in loser and winners.

RESULTS

Serum T and C significantly increased in fixed players before and after the game (p=0.000). Table 1 shows T and C changes after winning or losing. This table shows that these hormones did not significantly change in loser and winners (T and C before and after the game p=0.160, p=0.109, p=0.49, p=0.66 respectively).

Table 1: SD and level of significance of T and C before and after the game in losers and winners

	Variable	Condition	Mean	Sig.
1	T before the game	Winner	0.525	0.491
		Loser	0.630	
2	T after the game	Winner	0.792	0.666
		Loser	0.840	
3	C before the game	Winner	107.750	0.160
		Loser	108.270	
4	C after the game	Winner	149.400	0.109
		Loser	179.600	

Independent t test

Table 2: SD and level of significance of T and C before and after the game in fixed players

	Variable	Condition	Mean	T value	Sig.
1	T	Before the game	30.00	5.408	0.000*
		After the game			
2	C	Before the game	95.23	8.183	0.000*
		After the game			

Paired sample t test

DISCUSSION

The review of related literature shows contrary data of a biopsychological reaction to stressful stimulator due to different variables. If previous data of a hormonal reaction to a sport competition and the outcome is considered as a component of competitive response to a competition, a collection of physiological-psychological variables are effective in hormonal changes.

The first result of this study was a significant increase in T with strong anabolic effects as well as C with catabolic effects in fixed players after an official basketball game (Table 2). In recent years, research indicates that ergogenic drugs such as anabolic-androgenic steroids, growth hormone, creatine and other supplements are increasingly consumed by younger athletes for potential gains in body mass and strength and performance at the beginning of their professional sport life [32]. One reason why T and C changes cannot be investigated in professional athletes and real match conditions is a lack of control over these athletes' nutrition and their supplement consumption in real match conditions. As the subjects of this study completely controlled their nutrition and did not consume any supplements or drugs, it can be stated that psychological-physiological aspects of the official basketball game dramatically increased T hormone. It should be mentioned that as this game was very important, the players participated with their highest level of power; therefore, this game probably has played the role of a maximal exercise with a short-term rest interval in increasing female athletes' T hormone. This finding is contrary to Allen Booth who reported T changes after the game in men [33]. Some researchers believe that three factors play an important role in increasing T in strength training: intensity of training, number of movements and muscle mass [34]. In the present study, all these three factors can play a role in increasing T hormone if the nature of the basketball game is paid attention to. On the other hand, the subjects of this study consisted of young basketball players who did not gain control over mental challenges and stress in an important game as they were not much competitively experienced. As a result, the significant increase of T during the game can result from the subjects' age.

Mental pressures and stress following physical activity change C which plays an important catabolic role in the body. Various results of C changes have been reported in male and female athletes [9]. The significant changes of C in this study may result from high mental pressure of fixed players and the magnitude of the game. C is recognized as the most important stress hormone which motivates the catabolic process in the body.

Another finding of this study was the lack of a significant change in T and C depending on winning or losing after the game (Table 1). It should be mentioned that T and C levels were higher in the loser team than the winner team, but this change was not significant. Most researches which reported a significant change in these hormones following winning or losing were carried out for individual sports such as tennis, wrestling, chess and judo [9] while only few researchers studied team sports. The reason can be the higher importance of individual's mental interaction in the team and the effect of team on the athlete's condition rather than the effect of the outcome while in an individual sport, the individual knows only himself responsible for winning or losing; this fact can greatly affect his physiological and psychological condition and as a result T response to winning or losing.

Mazur's biosocial status theory [9] shows that T levels rise after a successful dominance confrontation which in turn signals to the individual that further actions can be taken to maintain or enhance status. Therefore, as status increases, so does T and as T increases so too does an individual's behavior towards acquiring status. In contrast, after losing a dominance contest, T levels should decline and the individual should likewise flee from the competition to avoid further insult or loss of status. Contrary to this theory, some researchers believe that the outcome does not change T after sport games [9] while others report these changes only in men and claim

that with respect to the low T secretion in women, this hormone does not significantly increase following a physical activity and winning or losing [33]. Another reason why T did not increase in female winners is the hypothesis of Taylor *et al*., (2000) which states that men are more likely to fight-or-flight in stress situations whereas women are more likely to tend-and-befriend. With respect to this idea that if the game is more aggressive, T may increase more, T increase in women is a lower probability depending on winning as the friendlier the game is, T increase is lower [35]. This fact may predict the reason why T and C did not change between winners and losers.

Other studies show that winning or losing does not change T concentration; on the contrary, if the individual assesses a competition as if his competitive pattern is defined as a conformity pattern (previous experience) along with sympathetic nerve stimulation (SNS) (proactive reaction), victory will be more probable while if a non-proactive reaction is used (e.g. coach's role), the probability of defeat along with a decrease in T and an increase in C and negative mood will increase. If the individual assesses the game as important, he may use a proactive reaction; this reaction in turn increases T and activates SNS and finally positive mood can be predicted in the individual. Some adjusting factors of hormonal reactions to competition such as physical fitness, physical endeavor and nervousness play an important role [9, 36-38].

Most researches on male subjects show that short-term physical activity (10-20 min.) rarely increased T concentration. Other researchers showed that when the physical activity reaches 20-30 minutes, T significantly increases. When the physical activity continues, this T increase continues as well and after the activity finishes, T starts decreasing to reach its basal level [27-30].

CONCLUSION

With respect to the findings of the present study and a dramatic increase in T immediately after the game in female basketball players, it can be concluded that their physiology is exposed to the T effects. T as a strong androgen is accompanied by the desire to participate in masculine activities, aggressive behavior and voice change. Another finding of this study which expresses the stressful effects of female basketball games is the C increase. Side-effects of C increase in Iranian elite female basketball players who are involved in important games during two or three consecutive days will increase rest interval, inappropriate nutrition, inappropriate time schedule of games and training, incidence of injury and overtraining syndrome. Regarding T and C responses in basketball, it is essential that coaches more deeply investigate T and C changes in different training seasons and professional games. Periodic recognition and control of these hormones by coaches can play an important role in women's health and welfare. However, more research is needed to investigate the effects of different physical activities on T and C changes as well as the role of these changes in their sport performance.

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