

THE RELATIONSHIP BETWEEN PLASMA LEVELS OF TESTOSTERONE AND CORTISOL CONCENTRATIONS RATIO AND PSYCHOLOGICAL OVERTRAINING SYMPTOMS IN ELITE FOOTBALL REFEREES

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Abstract

Overtraining syndrome is a chronic situation that results from long periods of high intensity and volume work without rest periods. The purpose of this study was to determine the relationship between plasma testosterone and cortisol concentrations with psychological overtraining items (by Consensus group on overtraining of the Societe Francaise de Medecine du Sport) in football referees. Thirty football referees ($X \pm SD$: age 28.9 ± 4.54 year; height 178.9 ± 6.45 cm; weight 77.5 ± 9.23 kg; BMI 22.96 ± 2.14 kg/m²; Vo_2max 51.21 ± 2.53 ml/kg/min) volunteered for the study during a rest day (24 hours without training). They were asked to complete the overtraining questionnaire contains 54 question requiring answers of "yes" or "no". Then plasma samples were taken at rest and immediately after agame of Isfahan premier league (vision of Asia). The results of data analyses showed that the overtraining score from questionnaire correlates with cortisol concentration on rest day respectively ($r=0.71$), and testosterone/cortisol ratio ($r=-0.42$; $p<0.05$). Result show that the questionnaire may be a useful tool for monitoring and preventing of overtraining syndrome.

Keywords: CORTISOL, TESTOSTERONE, PSYCHOLOGICAL QUESTIONNAIRE, OVERTRAINING

Introduction

The way of exercising, the kind of training, scheduling training and rest intervals between exercises are very important factors in planning the training programs. If the standards of any of these factors are not followed in planning, some serious issues like overtraining may happen (22). There are many definitions for overtraining in different sources; but most experts suggest that it could happen through the heavy and long-term exercise without or very short rest between them (22, 5 and 3). Overtraining is associated with various physiological, psychological, immunological and functional symptoms (11). If this problem is not diagnosed or removed in-time, it may keep the athlete away from the competitions for months. One important physiological symptom is anabolic or catabolic hormones concentration (it shows the level of the effectiveness of the exercise).

Testosterone as anabolic hormone and cortisol as the catabolic hormone have the key role (22, 20). Results of different studies suggested that if the ratio between these two hormones falls below 30 percent and this reduction continues for a long time, the athlete is suffering from overtraining (15).

Testosterone is an anabolic hormone that stimulates the process of protein synthesis and as a key role in growth and maintaining the muscles tissues (19, 2). Cortisol is a catabolic hormone and in fact, is the most stress relief hormone in the body. Long term increase in this hormone levels can cause serious immunological problems (8).

The current methods used for studying the level of exercise impact on the body are expensive and time consuming, so they

aren't always applicable. The indirect methods of studying the physical and psychological conditions are used in recent years. One of these methods is to use standard self-reporting questionnaires (18, 10). Based on the athletes' answers to the questions, the experts can analyze their physical and psychological conditions.

In another study (2002), the results of those athletes' questionnaire that showed early symptoms of overtraining, were picked and the athletes were tested for concentration of testosterone and cortisol in professional rugby players (Massou et al; 2002). The results showed a significant and reverse relationship between results of questionnaire and concentration of testosterone ($p \leq 0.01$; $r = -0.6$) (6), while there was not significant relationship between results of questionnaire and concentration of cortisol (22).

In another study (Maria et al; 2003) the results of mental questionnaires, Hamilton depression test showed meaningful and positive relations ($P \leq 0/05$, $r=0.34$). Many other studies also suggest that the intensive and long term exercises together with high levels of stress can cause an increase in the level of cortisol.

According to Hendzysky et al (2006) 10 to 30 percent of professional football players suffer from some overtraining symptoms at the end of season. These players had high cortisol levels and also their muscle mass was reduced (15).

Note that direct methods involves spending a lot of time, so the researchers decided to analyze the relations between the results of French association of sport medicine's psychological questionnaire of overtraining (7) and the concentration of testosterone, cortisol and testosterone to cortisol ratio as

physiological parameters in relation to physical pressure and overtraining in football referees.

Stress is one of the inevitable effects of sport and exercise that involves athletes and also referees. Psychological stress can be made by many factors and can affect different physiological factors. Stress may occur by hormones or metabolic and cardiovascular changes (28, 29 and 31). Stress may be a risk factor for immunological performance and can affect health of athletes and referees. While, recently an assumption has been made by researchers that high level of psychological stress may make high affinity to illnesses and immunological factors (1, 30).

About definition of overtraining and psychological stress in athletes and coaches, many studies have been done, while one of the susceptible factors in sport competitions is refereeing that their decisions are affected by psychological stress, metabolic and physiological factors. So the main purpose of this study was to verify the relationship between plasma levels of testosterone and cortisol concentrations with psychological overtraining symptoms in elite football referees.

Methodology

Subjects

The present study is a defining study in general and a study of correlation in specific. This research was descriptive and the sample group includes all professional football referees in the Premier League of Isfahan (VISION OF ASIA) 2010-2011. Thirty football referees were chosen out from this group; none of them were suffering from hormonal abnormalities or

taking any hormonal medicine. After taking the necessary permission of Isfahan football association, the samples were examined in the process of the study and referees completed related consent letter. First samples (venous blood samples) were taken from their forearm in a seated position when they were spending a rest day and away of stressful conditions of match (in the middle of week) in Takhti stadium and in weekly meeting of referees. Second sampling was taken immediately after match. Table 1 shows the anthropometric and physiological impacts of referees.

Table1. Antropometric and physiological impacts of refereess

| Characteristic | Mean | SD | Max | Min |
|--------------------------------------|-------|------|-------|-------|
| Age(year) | 28.9 | 4.54 | 36 | 23 |
| Height (m) | 178.9 | 6.45 | 189 | 165 |
| Weight (kg) | 77.5 | 9.23 | 91 | 64 |
| Body-mass index (kg/m ²) | 22.96 | 2.14 | 27.13 | 20.47 |
| VO ₂ max (ml/kg) | 51.21 | 2.53 | 54.19 | 46.28 |

Other examined variables were height, weight, body mass index, and maximum aerobic power in Cooper protocol for athletes. Body mass index was calculated by placing the numbers related to height and weight in the equation (squared height in meter/ weight in kilogram).

Hormone measuring method

In the resting day (24 hours without exercise) and immediately after the match, referees' plasma samples were taken. Immediately after each phase sampling, tubes transferred to specialized medical and pathology laboratory and the samples were frozen in -20 degrees Celsius. In order to determine the amount of cortisol and testosterone, kit of Boster immunoleader, made in China was used. Methods used to identify was ELISA.

Psychological questionnaire and the initial symptoms of overtraining

The referees were asked to answer the standard questionnaire on the same day that their plasma samples were taken. This questionnaire is a standard one made by French association of sport medicine and has been used in several

researches (22, 7). This questionnaire includes 54 question in form of "YES/NO" and number of 'yes' were scored. After a brief explanation about research objectives, referees were asked to answer the questions carefully and honestly. Although the questionnaire was standard, to be more certain about results, the validity of it was proved by asking the exercise physiology professors about it and its reliability was measured by Alfa factor of Crohnbach (It was equal 0/95). All of the matches had special importance for clubs and referees.

Statistical methods

The data were collected based on study objectives and the data of descriptive statistics and coefficient Spearman correlation were analysed with software of SPSS version 17.

Results

Table 2 shows the correlation between testosterone, cortisol and testosterone/cortisol ratio in rest day and immediately after football match with results of questionnaire.

Table2. The relationship between results of questionnaire and testosterone, cortisol and testosterone/ cortisol ratio

| Hormone | Coefficient of correlation | Level of signification | Result |
|------------------------------|----------------------------|------------------------|--------|
| TESTOSTERONE | | | |
| REST | 0.46 | P<0.038 | + |
| MATCH DAY | 0.39 | P<0.076 | - |
| CORTISOL | | | |
| REST | 0.74 | P<0.006 | + |
| MATCH DAY | 0.65 | P<0.001 | + |
| TESTOSTERONE/CORTISOL | | | |
| REST | -0.49 | P<0.004 | + |
| MATCH DAY | -0.41 | P<0.085 | - |

+ Significant correlation (p<0.05)

The results of data analyses showed that the overtraining score from questionnaire correlates with cortisol concentration on rest day respectively (r=0.74), and testosterone/cortisol ratio (r=-0.49; p<0.04).

Evaluation of results of overtraining questionnaire

Average of score resulted from overtraining questionnaire was 20.1, maximum score 26 and minimum 11. In massou’s research average of scores was 9.5.

Discussion

The purpose of this study was to define the relationship between testosterone, cortisol and their ratio with results of overtraining questionnaire in elite football referees. Various studies have shown that heavy exercise without adequate rest intervals and stress caused by sports in long term cause changes in physiological status, immunological, psychological, and functional of referees that eventually referees will drop function (25, 22 and 14). In these conditions, concentration of hormones change and body go into catabolic condition. Gabriel and colleagues (1995) in their study associated with hormone changes

during more exercise, observed significant increase and decrease respectively in concentration of cortisol and testosterone (12). The phenomenon of overtraining causes changes in mental status of athletes.

In recent years, the use of tools that could be clarified symptoms of overtraining has been developed. The questionnaire used in this research is one of them (32, 17 and 10). Ben Haddad et al (1999) after using this questionnaire declared that it is a suitable tool for athletes susceptible to have overtraining symptoms. They did their research on many football, volleyball and karate players and showed a positive and significant relationship (P ≤ 0 / 05; r = 0 / 38). Meanwhile, the results of their research showed that athletes with symptoms of overtraining have less iron, ferritine and Insulin like Growth Factor Binding Protein (IGFBP). Results of cortisol of this study were most consistent with findings in previous research (p ≤ 0 / 05) (23, 15 and 13). However these results were in contraire with results of Massou et al (2002) in rugby players (22). It seems these sports were different mentally or physically (rugby or football). Increase of cortisol may be due to overactivity of hypothalamus - pituitary – adrenal axis.

Heavy exercise can increase overactivity of hypothalamus - Pituitary - adrenal axis and ultimately increase chronic cortisol concentrations in the body (9). Also, various studies have shown that there is significant relation between the concentration of cortisol immediately after rising from sleep and stress conditions in body (32, 24). According to previous research and the results obtained in this study, it seems physical and mental stress change concentration of cortisol and finally may increase concentration of cortisol chronologically. On the other hand, the results of this study showed that there was significant and positive relationship between results of the questionnaire and concentration of testosterone only at rest. Locke et al (1995) stated testosterone concentrations in response to exercise can increase or decrease (21). Ratio of testosterone and cortisol is one of the most valid indicators of overtraining. In fact, this ratio is representing of catabolic or anabolic condition in body. This ratio reduces when overtraining occurs. In fact, the results of this study were aligned with results of previous studies has been done in this area (22, 20, 15, 14, 4). There was significant relationship between ratio of testosterone/ cortisol at rest and results of questionnaire. Result show that, the questionnaire may be a useful tool for monitoring and preventing of overtraining syndrome.

Conclusion

Finally, given the high correlation for results of overtraining questionnaire and cortisol concentration at rest, we can conclude that questionnaire of overtraining is an appropriate a suitable tool for predicting of overtraining syndrome. On the other hand, according to these results, it can be concluded that for determining the amount of exercise pressure in athletes and referees evaluation of testosterone/cortisol ratio is valid and useful.

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