Journal of Sports Physiology and Athletic Conditioning (J.S.P.A.C) 2023; 3(7): 23-35

Research Article

The Effect of Tapering Period with and without Creatine Supplementation on Hormonal Responses of male football Players

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Received: 30 August 2022
Revised: 7October 2022
Accepted: 8 December 2022

Abstract

Background: The aim of this study was to examine the effects of a tapering period with creatine supplementation on hormonal responses of men football players.

Materials and Methods: The study sample included 18 male soccer players of the first division league (mean age: 18.77 ± 1.26 years, height: 174.5± 5.77 cm, and weight: 64.07± 6.99 kg) that were in the specific conditioning period who were randomly divided into two equal groups: Taper alone (n=9) and Taper with creatine supplementation (n=9). The levels of blood hormonal parameters including testosterone, cortisol and testosterone to cortisol ratio (T/C) were measured before and after the tapering period (10 days). Paired t-test and independent T-test was used to examine the differences within and between groups, respectively.

Results: The results showed that the cortisol levels in the post-test compared to the pre-test decreased significantly in both groups ($p \leq 0.05$) ; While, there was no significant difference in testosterone and T/C ($p \geq 0.05$). Also, no significant difference was observed in the levels of testosterone, cortisol and T/C between the two groups.

Conclusion: The taper period can reduce the cortisol levels of male soccer players, but creatine consumption has no significant effect on the levels of cortisol, testosterone and T/C ratio in the taper period.

Keywords:
Taper, Anabolic hormones, Katabolic hormones, Elite soccer players.

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Journal of Sports Physiology and Athletic Conditioning

1. Introduction

The efforts of athletes, coaches, and sports science experts have always been to identify the facilitating and limiting factors of sports performances (1). Football players cover a distance of about 10 kilometers with 70 to 80% of maximum oxygen consumption. Long-term activity with this intensity is dependent on glycogen and metabolic substrates. In a soccer match, the reliance on each energy system is constantly changing. Getting the desired training balance is complex and depends on special knowledge about the metabolism and physiological changes of the athletes of that sport (2,3).

The levels of testosterone and cortisol in the plasma indicates the anabolic and catabolic reactions of the tissues. Also, the ratio of testosterone to cortisol is used as an indicator of training load (4). The increase of some hormonal indicators during special football activities is one of the training adaptations; Also, overreaching or overtraining also shows similar compensatory adaptations (5). 10-30% of professional players suffer from overtraining syndrome at the end of the competition season, which affecting the hypothalamus-pituitary-adrenal (HPA) axis is one of the most important effects of this syndrome (6). On the other hand, a rest period at the end of the competition season is common in all sports fields, in order to prevent proteolysis and a decrease in the performance of physiological indicators (hormones, immune system, etc.) caused by overtraining (7). Appropriate and correct adjustment of sports exercises requires deep sciences related to sports performance, including physiology, psychology, nutrition and technical aspects (8).

One of the key elements of the athletes' physical preparation is the period of gradually reducing the training load in the weeks before the start of the competition, which is commonly known as Tapering. The taper period prevents accumulated fatigue caused by long periods of training without reducing training adaptations and helps to maintain the athlete's fitness and performance. Decreasing training load requires a careful plan, which is often used synonymously with maximizing performance. In general, a taper period is defined as a period of several days to several weeks in which the volume of training is gradually reduced while the intensity of training is maintained relatively. However, the combination of volume and intensity applied during the taper period depends on the type of sport and the desired adaptations for a successful sports competition (9).

Most of the conducted studies have investigated the effect of the taper period in individual sports (mainly endurance sports) such as running, swimming, cycling, rowing and triathlon (10,11). While there is little information about the effect of reducing the training load in team sports including football.

However, professional soccer players who participate in constant club competition and international tournaments seem to have little time for tipper, which is likely to impair their performance - it depends on a combination of physical, physiological, psychological, tactical, and technical factors - in important competitions (12).

A large number of athletes use energizing nutritional supplements to improve the quality and quantity of training and actually maintain their performance in competitive conditions. It is possible that additional nutrients may be necessary for athletes during intense training (13). In fact, under certain circumstances, energizing supplements can have positive effects on athletic performance, body composition, and strength (14). Due to the many demands of football, including shuttle, fast and explosive movements and jumps, which are often performed with short recovery periods during 90 minutes of competition (15), football players can take energizing nutritional supplements including creatine to benefit. Creatine supplementation increases the amount of muscle phosphocreatine at rest, which can be effective as an immediate phosphate transporter for ATP regeneration during activity. Increasing creatine in athletes allows access to a higher training load, reduces training fatigue, and improves performance (16). It has been shown that a short period of creatine consumption (5-7 days) increases total creatine of muscle by 20-50% .Also, creatine can increase the synthesis or decrease the breakdown of proteins (16). The coordinated metabolic function between dietary supplements such as creatine and physiological factors can play an important role in strengthening hormonal reactions and improving sports performance (17). However, few studies have been conducted on the effect of creatine supplementation on the changes in the reactions of anabolic hormones, and their results are not consistent with each other.

Considering the physical demands of football and considering the common beneficial effects of reducing the training load and short-term creatine supplementation on hormonal adaptations to improve sports performance, it is worth investigating whether the use of both of these strategies in football players, does it have an effect on the performance of the anabolic-catabolic hormone index and the positive balance of these hormones or not?

On the other hand, it is possible that the use of supplements and nutritional considerations can have a positive effect on the balance of anabolic-catabolic hormones during periods of reduced training load, which requires more extensive research (18). Therefore, considering the importance and position of football, as well as the role of the tapering period and nutritional considerations on the physiological and functional indicators of athletes, such as the effects of anabolic-catabolic hormones, especially testosterone and cortisol, on the mental-functional changes of athletes, the aim of this study was to compare the effect of a tapering period with and without creatine supplementation on the hormonal responses of football players.

2. Materials and Methods

The participants of this study were 18 football players of the Premier League of Tehran province province (average age: 18.77 ± 26.1 years, weight: 64.07 ± 99.6 kg, and height: 174.50 ± 77.5 cm), who were selected through purposeful sampling and randomly divided into two experimental groups (G1: taper with creatine supplement, G2: taper alone). First, 18 football players working in the Tehran Premier League, who were in a special training season and had the conditions to enter the study, were randomly divided into two equal groups. At first, all research steps and possible benefits and consequences were explained to the participants, and those interested in participating in the research completed a written consent form.

The load reduction period was performed after the completion of a 4-week conditioning period for these players. In this course, the researcher, in coordination with the team's coaches, considered the amount and intensity of the players' physical, technical, and tactical exercises almost identically. However, due to the limitations in controlling the volume and intensity of team athletes, there was a possibility of a slight increase in the intensity or volume of some players. Twenty-four hours after the end of the last session of the special conditioning period, and 24 hours after the end of the tapering period, in order to measure dependent variables, venous blood samples were taken from the participants after 8-12 hours of fasting. At each stage, 5 cc of blood were taken from the internal cubital vein of the participants and immediately transferred to a specialized laboratory for analysis. Testosterone and cortisol levels were measured before and after the tapering period by enzyme-linked immunosorbent assay (ELISA).

Intervention

Nutritional supplementation

Subjects were randomly divided into two experimental groups, include: 1) G1: Tapering period with creatine supplementation(N=9), G2: tapering alone(N=9). The participants of group one received 10 grams of creatine supplement twice a day during the tapering period for 10 days. The second group only did the tapering program without creatine supplementation. The participants of both groups maintained their diet and physical activity routine during the study. And they were asked not to have any physical activity and exercise beyond the designed protocol.

Conditioning and Tapering period

The tipper period, which was applied at the end of the special preparation period and before the start of the competition, included reducing the frequency of training (from 5 sessions to 4 sessions per week), reducing the volume of training (from 90 minutes to 60 minutes per session while maintaining the intensity of the training). The amount of training load changes was considered based on the recommended index of reducing training load in team athletes (1). The conditioning training period (befor tapering period) included the following parts: 1) Fifteen minutes of warm-up, 2) Ten minutes of individual technical movements with the ball, 3) Twenty minutes of high-intensity group tactical training, 4) Fifteen minutes of speed training and plyometrics and 5) Playing football for twenty minutes and finally 6) Cooling down for ten minutes. The exercises of the tapering period included: 1) Ten minutes of warm-up, 2) Ten minutes of group tactical exercises with high intensity, 3) Ten minutes of speed and plyometric exercises, 4) Twenty minutes of playing football and 5) Ten minutes of cooling down.

Statistical analysis

The Kolmogorov Smirnov test was used to evaluate the normality of the data distribution, and the Levine's test of homogeneity of variance were used to establish the homogeneity of variance between groups. Dependent t-test was used to examine within-group differences before and after the test, and independent t-test was used to examine between-group differences. Data were analyzed using SPSS software version 26. Significance level was considered to be equal or less than 0.05.

3. Results

The participant demographic are presented in Table 1. Therefore, within-group changes of testosterone and cortisol serum levels and T/C ratio are presented in Table 2. All groups reported homogeneous variance (P > .05). Also, at the beginning of the study no significant differences were observed between the groups in levels of cortisol, testosterone and T/C ratio (P<0.05).

The results of this study showed a significant decrease in the level of cortisol hormone after the post-test compared to the pre-test in both groups (Taper group: P=0.02; and Taper with creatine group: P=0.04); While there were no significant changes in the levels of testosterone and the testosterone to cortisol ratio (T/C) (Taper group: P=0.3, P=0.07, Taper with creatine group: P=0.09, P=0.06). Also, no significant difference was observed in the levels of testosterone, cortisol and T/C between the two groups(P≥0.05).

4. Discussion

The aim of this study was to investigate the effect of creatine supplementation during the tapering period on anabolic and catabolic hormones. The results showed that reducing the training load during the tapering period with and without creatine supplementation leads to a decrease in serum cortisol levels and has no effect on testosterone level and T/C ratio (Figures 1,2,3). Therefore, reducing the training load during the tipping period leads to improved performance due to the reduction of training stress and improvement of recovery before the competition.

Tapering is a way to relieve the fatigue caused by long training periods without reducing training adaptations. Reducing the volume of training while maintaining the intensity of training in a period of several days to several weeks is called tapering. The volume and intensity of the exercises in the tapering period depends on the type of sports (19). Studies have shown that a 7-21 day tapering period improves performance. Among the factors that play a role in this case, hematological, biochemical, and hormonal factors, immune system, and mental-psychological factors are mentioned (2,3,7,8). The levels of testosterone and cortisol in the plasma indicates the anabolic and catabolic reactions of tissues. The results showed the testosterone levels increased in both groups, but it was not statistically significant (Figure 1). Several studies have reported increased testosterone levels (6,20); While Consistent with the results of this study, several studies did not report significant changes (14,17).

The results of this study showed that the level of fasting blood cortisol in the post-test compared to the pre-test was significantly reduced in both groups.

But statistically, no significant difference was observed between the two groups (Figure 2); Consistent with the results of this study, several studies have reported decreased in cortisol levels (4,5,6); In contrast the studies of Mojica et al. did not find significant changes (19).

Casteel et al. (1991) observed a decrease in resting cortisol by 23-30% and an increase in testosterone concentration by about 22% during tapering period in swimming competitions, at the same time as a 3.2% improvement in performance (21), also Driesenderfer and Colleagues (2002) reported a 5.3% increase in serum testosterone and a 4.6% decrease in urinary cortisol in cyclists during 10 days of tapering period along with a 1.2% improvement in performance (22). The mechanisms of testosterone increase after a period of load reduction can be through the relationship of the pituitary gland and the response of the temporal processes of exercise intensity, the positive stimulating effects of androgenic-anabolic activity during load reduction sequences, which are characterized by the reduction of physiological stress levels. (6).

Hortbagy et al. (1993) reported a significant increase in testosterone and the T/C ratio along with a decrease in cortisol during 14 days of reduce load and suggested that a short-term tapering period could indicate increased tissue stimulation, and this hormonal change is a reflection of the state of the muscle tissue or functional output responses before blood sampling, which is dependent on the stimulation of the intensity and volume of exercises (23).

On the other hand, Mujica et al. did not observe significant changes in the amount of testosterone, cortisol, T/C ratio and performance during 800 meters running during a 6-day tapering period; While in another study on the same group, authors reported an increase in testosterone levels in parallel with improved performance (24). Based on this, it has been suggested that long-term training and low-intensity training prevent the stimulation of anabolic processes by testosterone; While in intermittent intense training, this stimulation of anabolic processes is facilitated (24).

Creatine supplementation increases the amount of muscle phosphocreatine at rest, which can be effective as an immediate phosphate transporter for ATP regeneration during activity. Also, increasing free creatine in muscles at rest can increase regeneration during and after exercise and also facilitate energy transfer from mitochondria to parts where ATP is consumed. On the other hand, increasing the role of tampons (buffering) for hydrogen ions that prevent acidosis of muscle cells is also important for football players. Increasing the concentration of creatine in athletes allows training with higher training loads, reduces fatigue, and increases muscle hypertrophy, which can improve performance (7,14,16,17). Creatine can increase the synthesis or decrease the breakdown of proteins. Based on this, it is possible that creatine consumption can help to increase the effectiveness of the tapering period after the competition season or the training period with high intensity or volume of training (18).

The coordinated metabolic function between nutritional supplements such as creatine and physiological factors can play an important role in strengthening hormonal reactions and improving sports performance (18). Few studies have been conducted on the effect of creatine supplementation on the changes in the responses of anabolic hormones, and their results are inconsistent. However, in this study, the short-term use of creatine supplements could not have significant changes in the 10 days of tapering period on the levels of these hormones (figure 1-3). In general, it can be concluded that the training model (intensity, volume, and training pattern) and the time of tapering period can have a more influential role than food supplements. However, this issue needs more and more detailed investigations. Researchers have used the T/C ratio as an important indicator of exercise stress (18,21). The results of this study showed that the T/C ratio increased in the tapering and tapering groups with creatine supplementation in the post-test compared to the pre-test; but it was not statistically significant (Figure 3). Also, there was no significant difference in T/C ratio between two groups.

Most of the studies conducted in the field of muscle damage and anabolic-catabolic balance have used the T/C ratio (19.24). Martinez et al. (2010) reported a favorable anabolic-catabolic balance during the study of cortisol, testosterone levels and T/C ratio of elite basketball players during the competition season. And they found it useful to use the ratio of cortisol, testosterone and T/C changes in preventing stress and controlling periods of returning to the initial state during the competition season (25).

Table 1: Demographic characteristics of the participants

Variable	Group	
	G1 (N=9)	G2 (N=9)
	Mean ± SD	Mean ± SD
Age (year)	18.11 ± 0.33	19.44 ± 1.50
Height (cm)	175.66 ± 6.41	173.33 ± 5.15
Body Mass (KG)	64.41 ± 6.51	63.70 ± 8.73

G1: Tapering period + creatine supplement; G2: Tapering period alone; N: Participant number; SD: Standard Deviation

Table 2: Within-group changes of testosterone and cortisol serum levels and T/C ratio

Variables	Group	N	Pre-test	Post-test	P value
			Mean ± SD	Mean ± SD	
Testosterone	G1	9	8.1 ± 3.15	8.88 ± 2.74	0.70
	G2	9	6.28 ± 2.78	6.83 ± 3.57	0.30
Cortisol	G1	9	155.60 ± 25.74	140.60 ± 26.66	**0.04 ***
	G2	9	164.7 ± 44.66	129.6 ± 35.74	**0.02 ***
T/C	G1	9	0.051 ± 0.01	0.064 ± 0.02	0.06
	G2	9	0.038 ± 0.01	0.055 ± 0.03	0.09

G1: Tapering period + creatine supplement; G2: Tapering period alone; N: Participant number; SD: Standard Deviation, T/C: testosterone to cortisol ratio

*** Significant at level P<0.05**

Conclusion

Therefore, in general, the results of this study showed that reducing the training load during the tapering period in team athletes such as football who have a relatively short and intense conditioning period can reduce the levels of catabolic hormones such as cortisol and improve the catabolic-anabolic index.

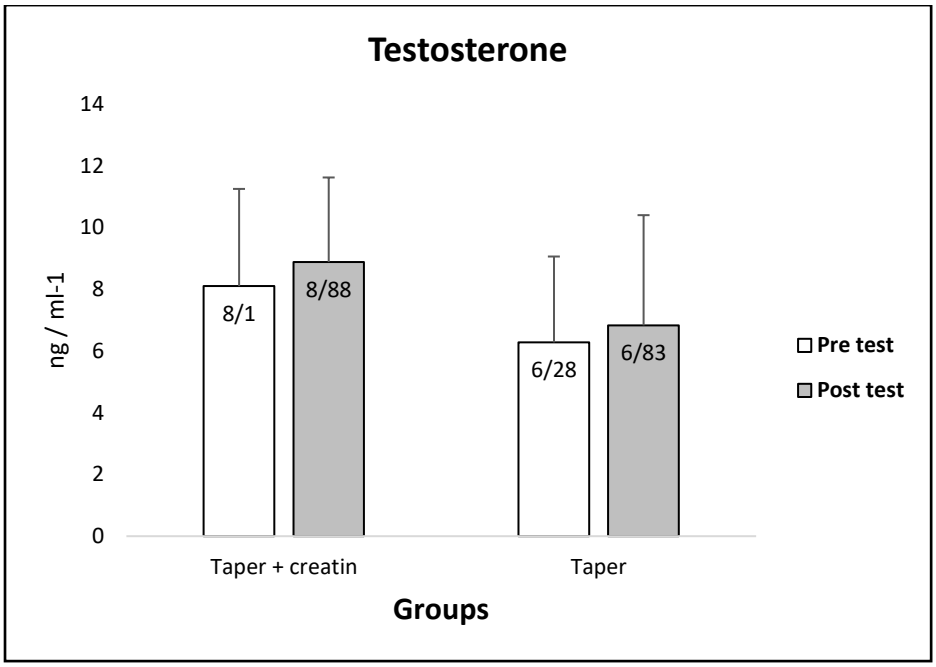

Figure 1: Intragroup changes in testosterone level pre-test and post-test.

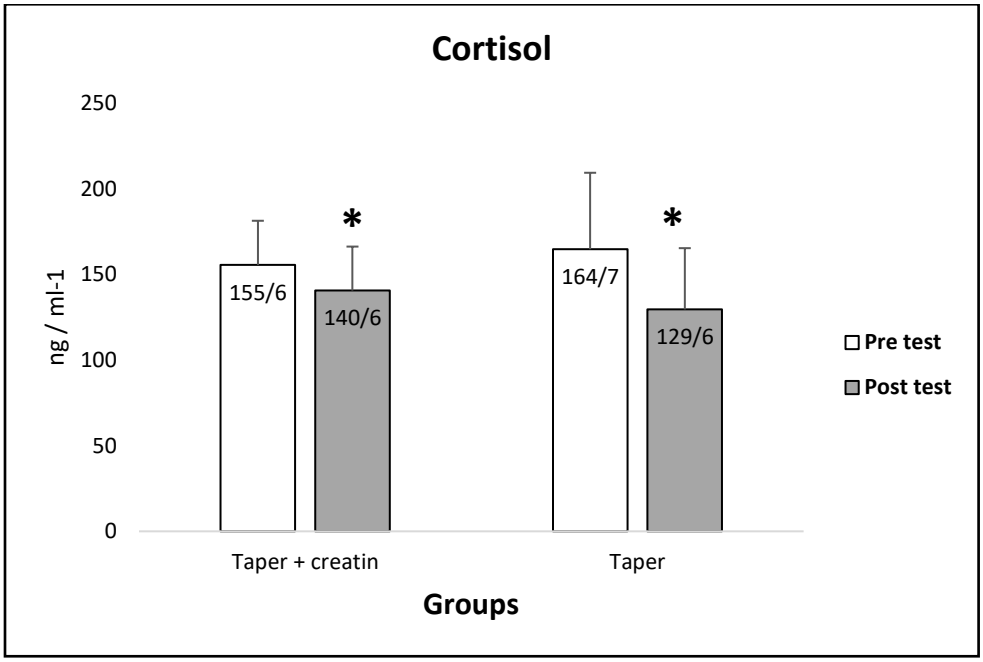

Figure 2: Intragroup changes in cortisol level pre-test and post-test.

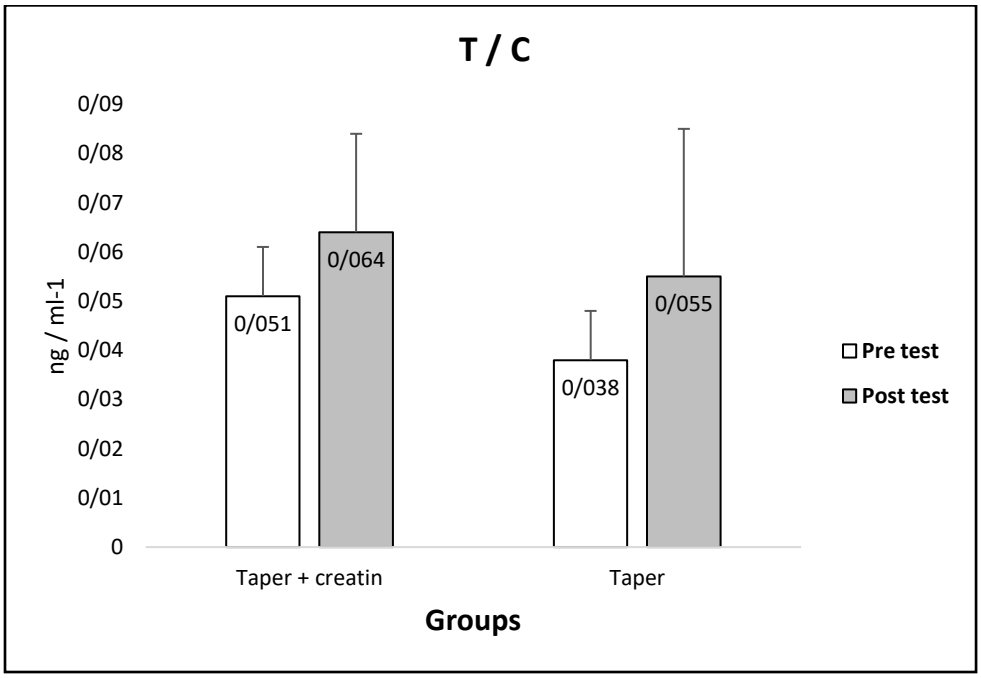

Figure 3: Intragroup changes in testosterone to cortisol ratio level pre-test and post-test.

Acknowledgements

The authors would like to thanks all the participants who participated in this research.

Funding

This study did not have any funds.

Compliance with ethical standards

Conflict of interest None declared.

Ethical approval the research was conducted with regard to the ethical principles.

Informed consent Informed consent was obtained from all participants.

Author contributions

Conceptualization: E.F., P.H., M.J.; Methodology: E.F., P.H., M.J.; Software: E.F., P.H., M.J.; Validation: E.F., P.H., M.J.; Formal analysis: E.F., P.H., M.J.; Investigation: E.F., P.H., M.J.; Resources: E.F., P.H., M.J.; Data curation: E.F., P.H., M.J.; Writing - original draft: E.F., P.H., M.J.; Writing - review & editing: E.F., P.H., M.J.; Visualization: E.F., P.H., M.J.; Supervision: E.F., P.H., M.J.; Project administration: E.F., P.H., M.J.; Funding acquisition: E.F., P.H., M.J.

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