



The Effect of Two Types of Sports Carbohydrate and Carbohydrate-Protein on Testosterone and Salivary Cortisol Following Two Quasi-Competitive Competitions in Male Wrestlers

Mahdi Faraji^{1*}, Ramin Amir Sasan², Javad Vakili³, Ahmad Motab⁴

¹ MA, Department of Sport Physiology, Faculty of Physical Education and Sport Sciences of Tabriz University, Tabriz, Iran.

² Associate Professor, Department of sport Physiology, Faculty of Physical Education and Sport Sciences of Tabriz University, Tabriz, Iran.

³ Assistant Professor, Department of Sport Physiology, Faculty of Physical Education and Sport Sciences of Tabriz University, Tabriz, Iran.

⁴ MA, wrestling coach and instructor, Faculty of Physical Education and Sport Sciences of Tabriz University, Tabriz, Iran.

*Corresponding Author

Abstract: *The ultimate goal of exercising is to improve performance. For this purpose, the athlete needs to increase the volume and intensity of the exercise, which is a factor that challenges the homeostasis of the body. The purpose of this study was to investigate the effect of dietary intake of carbohydrate and protein carbohydrate on testosterone and salivary cortisol following two quasi-competitive races in amateur male wrestlers. For this purpose, 16 wrestlers (amateurs) were selected based on physical characteristics such as: height 169.62 ± 10.99 cm, weight 63.09 ± 23.1 kg, 17.7 ± 3.70 years, fat percentage 14.97 ± 5.89 , Physical fitness, history of wrestling and body mass index were selected and the subjects were divided into two groups: the first group received carbohydrate and the second group received protein carbohydrate after a single blind crossover activity. Carbohydrate sport drink was (10% solution) was 6 ml / kg and protein carbohydrate sport drink was (10% solution) 8% carbohydrate and 2% protein. The subject's nutrition was identical on the day of the test and two separate control and experimental sessions were performed within one week. On the test day, the subjects held two wrestling matches with 10 minutes of rest between the matches. The unstimulated saliva sample in the first and second weeks of two stages and once before the match, after 30 minutes and 3rd time three hours after the competition and in total during six rounds were measured in two matches. The testosterone and salivary cortisol levels were measured by ELISA and the results were analyzed by SPSS software, Shapiroilk Statistical test and repetitive statistical analysis (ANOVA) was performed at a significant level of 0.05. In general, the results of this study showed that the response of testosterone, cortisol, and testosterone to cortisol ratio was similar between males and at 30 minutes and 180 minutes after two semi-competitive wrestles, and the type of supplementation did not affect the response pattern of these variables ($P < 0.05$). In addition, the levels of each of these indices did not differ between the two groups before the implementation of the competitive activity ($P < 0.05$).*

Keywords: Sports, Carbohydrate, Carbohydrate-Protein, Testosterone, Salivary Cortisol

INTRODUCTION

Wrestling is a very intense physical activity and requires physical fitness, exercise and adequate training, both of which are indispensable and essential to the wrestling training. In comparison with other disciplines, the wrestling has a variety of conditions for using muscle groups and techniques. There are over 500 techniques in this field that stimulate and strengthen most of the body's muscles. (Tedaye et al., 1997) The wrestle is an interdisciplinary field, and it entails a lot of pressure on aerobic and anaerobic energy devices. According to the studies, the share of energy production in the anaerobic and aerobic systems is 90% and 10%, respectively (Bell et al., 2000), It is counted as a short-term fields in terms of competition (Aslan et al., 1998) and is considered to be very intense HIT exercises. (McLaren & Morton, 2012) Duration of the race based on the rules of the Fila is two periods totaling 3 minutes and the energy consumption of the race is estimated at 54 to 59 kilojoules (Fathi, 2012). Therefore, high physical fitness such as anaerobic power and strength are essential physical factors in this sport. Studies and researches have shown that exercise affect blood levels of hormones and lead to a decrease or increase in the level of some hormones relative to rest condition (Agha-Alinejad, 2013; Fathi, 2012) In fact, these hormonal fluctuations can be considered as a reaction of the body to exercise stresses in order to establish a homeostasis state. (Lamir & Ganbari, 2006) Testosterone is considered as an important anabolic hormone with multiple physiological functions in the human body which is produced and secreted in men primarily in testicular leydig cells.

(Kiadeliri, 1999; Lamir & Ganbari, 2006; Bompa, 1994) Cortisol is also the main form of glucocorticoid in humans and catabolic hormone secreted from the cornea of the adrenal gland in response to physiological and psychological stresses (Deakin, 2004; Biewenga and Thjs, 1970; McLaren & Morton, 2012). Deylmay 4 (2013) reported in the research that a wrestling match will affect the amount of testosterone and cortisol. (Kramer, 1988; Bompa, 1994) These two hormones respond in a sport that suddenly reaches a certain threshold, reaching a concentration plate linearly, usually occurring at the end of the activity. (Jack et al., 2007; Federation, 2012) Exercise with 60% or more of maximum oxygen consumption is one of the physiological stresses that can increase cortisol secretion. (Deakin, 2004; Jurimae et al., 2004), The release of cortisol, by trying to help maintain blood sugar levels during physical activity, affects metabolism, and the extent of its secretion in exercise greatly depends on the duration of exercise. (Jurimae et al., 2004)

Previous studies have shown that there is a negative correlation between cortisol and testosterone hormones in a specific condition (Kramer et al., 1988). In studies on the effect of testosterone and cortisol in the combat sports was found that changes in testosterone and cortisol levels in these disciplines are tangible (Azerbaijani & Nikbakht, 2002; Federation, 2012), although these studies have so far not been able to explicitly examine this opinion statistically (Bompa, 1994).

In the study of Azarbaijani (2006) and Moradi (2013), the concentration of salivary testosterone immediately decreased after an interval of increasing exercise to fatigue limit, and this reduction was significant after 90 minutes of recovery period compared to resting time. Salivary testosterone concentration immediately after one increasing training session to fatigue limit decreased, and this reduction was significant after 90 minutes of recovery versus resting time. Concentration of salivary cortisol increased immediately and 30 minutes after exercise compared with relaxation time, but after 90 minutes, the concentration of cortisol was reduced and close to resting levels. Concentration of testosterone ratio to cortisol also decreased immediately after exercise, compared to resting values, and continued to decline for up to 90 minutes after training. Reducing the testosterone ratio to cortisol also indicates an anabolic and catabolic balance following a disabling activity, and thus can keep the body in a catabolic state. Additionally, increasing cortisol levels and catabolic conditions can lead to weakening of the immune system. (Boomaveri & Wiene, 2010)

Similar results were reported in James (1999) and Azarbaijani (1999). In these studies, after the wrestling, level of cortisol increased and testosterone level decreased by up to 90 minutes after recovery period (Viro, 2007; Zitzmann, & Nieschlag, 2001). To avoid catabolic conditions and reduce the proportion of testosterone to

cortisol, researchers have used a variety of strategies, including the use of Sport drinks like a carbohydrate drink and a protein carbohydrate drink. (Viro, 2007) In a study by Jeff et al. (2001) about the effect of dietary exercise combined with exercise on testosterone and cortisol levels, they found interesting results that the concentration of these hormones varies depending on the athlete's diet and after resistance training increases testosterone level. The combination of carbohydrates and protein leads to increased testosterone (Jac et al., 2007; Biewenga & Thjs, 1970; Henning, 1992).

Evans et al. (2001) stated that the addition of carbohydrate (6 percent glucose, sucrose) to provide energy and maintain normal blood glucose, and using sodium and potassium to keep water in body and better absorption of fluids and without preservatives and with carbonate form, have no problems with the stomach and is a good drink. Using carbohydrates before exercise causes anabolic environment in the body and catabolism is reduced. (Galbo et al., 2010; Deakin, 2004) Holst et al. (2008) stated that the use of protein immediately before and after exercise led to an increase in the body's anabolic environment and reduced catabolism Reduces (Zitzmann, & Nieschlag, 2001; Viro, 2007).

Given the limited research on the wrestling as the country's first sport and the lack of resources on carbohydrate and protein carbohydrate in the anabolic and catabolic conditions of wrestlers, the researcher sought more and more relevant information on the effects of the use of carbohydrate and protein_carbohydrate sport drinks on testosterone and salivary cortisol following two quasi-competitive matches in male wrestlers.

Methodology

The present research is applicable to applied research and in terms of data collection method is semi-experimental. In this cross-over study, 16 wrestlers were selected voluntarily and selected in a cross-over research project in two consecutive weeks after two quasi-competitive wrestling competitions with one of the Carbohydrate or protein carbohydrate drinks. In the first week, eight wrestlers consumed carbohydrate and eight other wrestlers consumed carbohydrate + protein and their hormonal response was checked and the test was repeated again in the second week with the change of drink type. At first, the subjects completed the Health Questionnaire Form, as well as written consent form. Initial measurements including height, weight, and fat percentage of the subjects were obtained. The height and weight were measured using a height gauges and digital scales. The percentage of fat (from the three-point Polar Jackson equation) and body mass index (BMI) were used to homogenize the research groups.

Findings

The personal features of the participants

Table 1. Average, Standard deviation with descriptive indices of male wrestlers. (n=13)

variables	Maximum level	Minimum level	Standard deviation	Average
Age(year)	24/1	14/4	2/85	18/03
Height(cm)	186	148	11/34	169/62
Weight(kg)	79/5	525/	7/83	65/73
Fat percentage	19/50	10/28	2/62	13/56

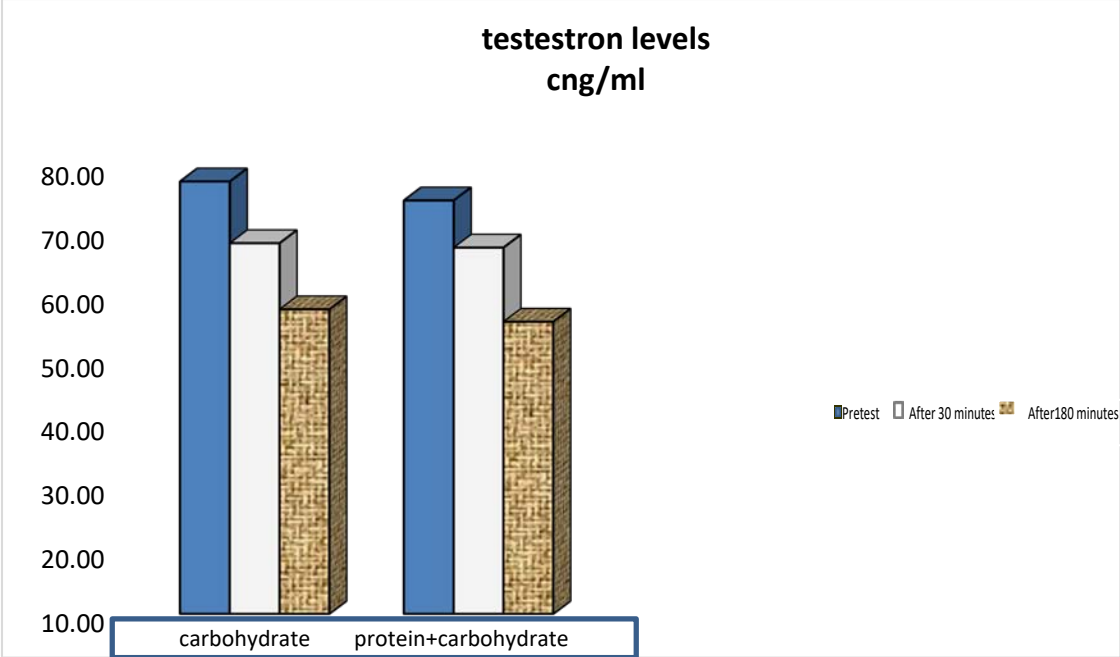


Figure 1. testosterone changes in different stages of measurement in two groups.

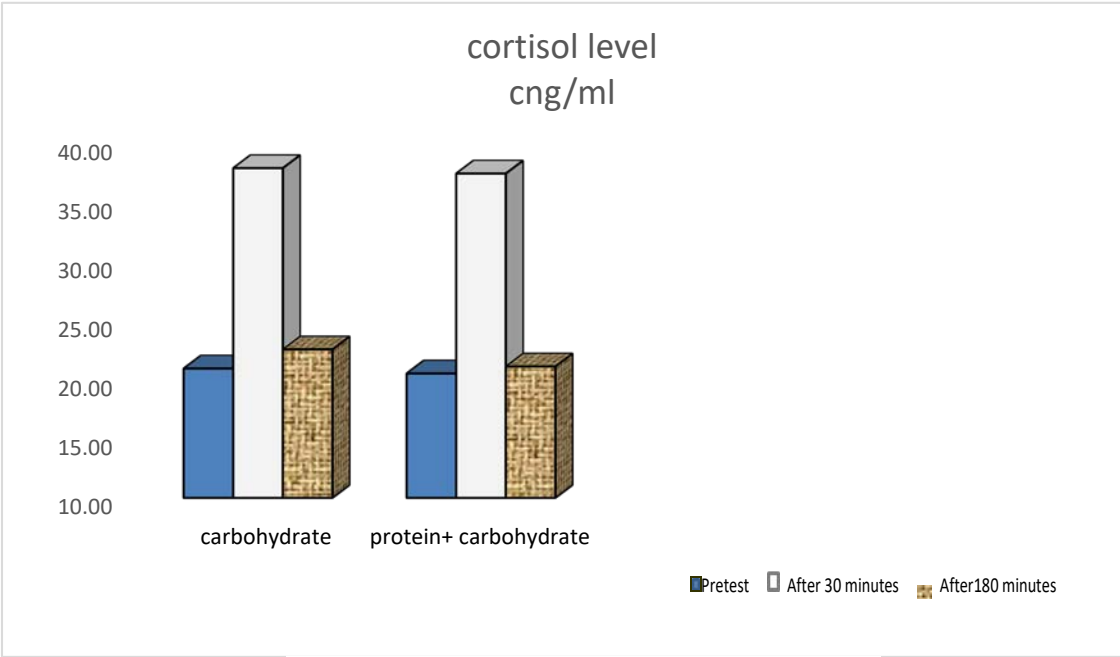


Figure 2. cortisol changes in different stages of measurement in two groups.

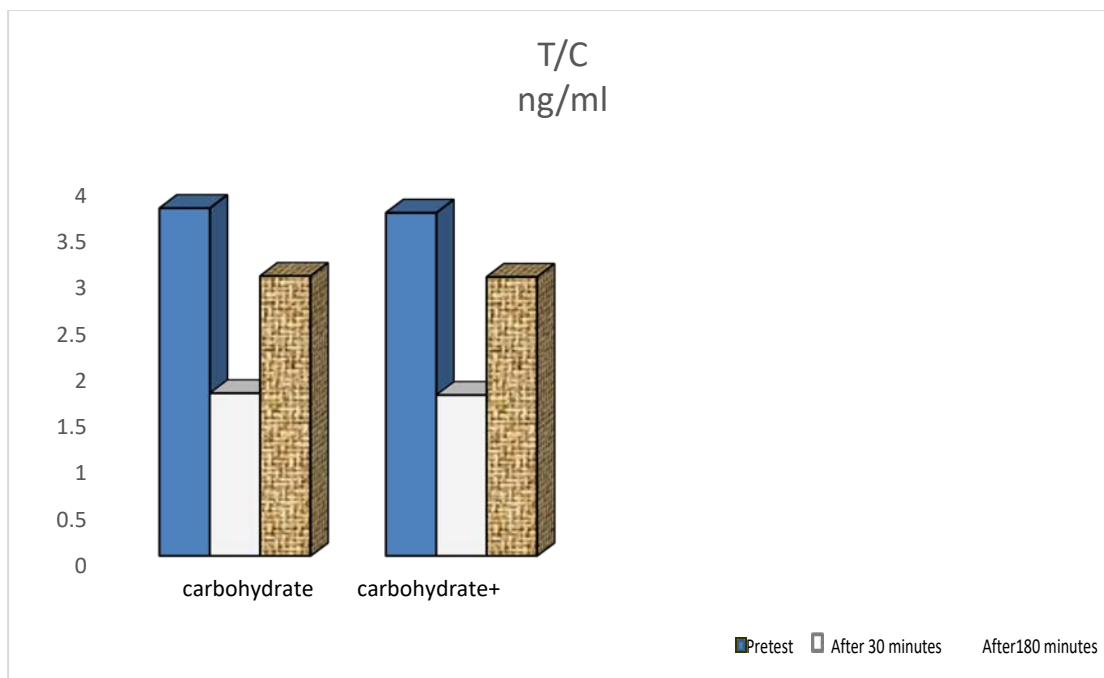


Figure 3. testosterone to cortisol ratio changes in different stages of measurement in two groups.

Discussion

The amount of cortisol and testosterone

The results of statistical analysis showed that there was a significant difference in testosterone and cortisol levels at different stages ($p = 0.000$). And the size of the independent variable is 26.0. Namely, the implementation of two quasi-competitive wrestle has led to changes in testosterone and cortisol levels. However, no significant difference was found between the two conditions of carbohydrate supplementation and carbohydrate + protein supplementation ($p = 0.946$). Also, the results of statistical analysis showed that there is no significant difference between the effect of measurement steps and type of supplementation ($P = 0/964$). In other words, there is no significant difference between the patterns of changes in testosterone levels in the two groups of supplemental substances at different stages of measurement. In addition, in examining salivary testosterone values by repeated ANOVA, the results showed no difference in salivary testosterone levels in the pre-test stage, after 30 minutes and after 180 minutes from two quasi-competitive wrestle. Therefore, the effect of two complementary carbohydrates and carbohydrates-proteins is similar. In the study of salivary cortisol values by repeated ANOVA, the results showed no difference in salivary cortisol levels in the pre-test stage, after 30 minutes and after 180 minutes from two quasi-competitive ships. Therefore, the effect of two complementary carbohydrate and carbohydrate - proteins was similar.

Salvador (1998) reported that a wrestling match would affect testosterone and cortisol. (Deakin, 2004) The difference in the exercise protocol and the type of nutrition of the subjects before the competition was the cause of this conclusion. These two hormones increase linearly in response to an exercise that suddenly reaches a particularly high threshold, by reaching a concentration plateau, this happens at the end of the activity. (Lymouei et al., 2011; Boostani et al., 2013) In a study by Zeinali et al.(2012) on 26 elite runners 19-year-old, Cortisol level increased in endurance runners.

In the Wilkerson study (1995), salivary testosterone concentration was immediately reduced after a training session to a fatigue limit, and this reduction was significant after 90 minutes of recovery versus resting time. Concentration of salivary cortisol increased immediately and 30 minutes after exercise, compared with relaxation time, but after 90 minutes, the concentration of cortisol decreased and close to resting values. The

concentration of testosterone to cortisol was also immediately after exercise compared to rest rates decreased and continued to decline for up to 90 minutes after exercise. (Azerbaijani & Nikbakht, 2002) The reason for the contradiction between the present results can be expressed in terms of the duration of competition and the amount of rest between competitions. The reduction of the testosterone to cortisol ratio also indicates that the anabolic and catabolic balance is suppressed following a severe activity and hold body in a catabolic state. (Azerbaijani & Nikbakht, 2002)

Studies have shown that testosterone levels have increased in speed runners. The conclusion is that the lack of a balanced diet for both endurance and rapid training groups (Zeinali & Salmani, 2012). In the Moradi's (2011) study, which was performed on nine non-athlete men, including twelve weeks of weightlifting practice, 3 sessions per week, 10 stations, 3 sets, 8 -12 repetitions in each stations, with an intensity of 60-80% of maximum repetition, rests between sets for one minute and between stations for two minutes, duration of training 60 minutes. Cortisol levels and testosterone did not change significantly (Moradi, 2012). Consistent with the findings of the present study, Hosseini et al. (2010) stated that Serum cortisol levels remained unchanged after eight weeks of strength training in young girls with low mobility (Hosseini, 2010). Unchanged Serum cortisol levels after a period of strength training can be explained with studies that investigated the acute and chronic effects of endurance training on the hypothalamus-hypophysis-adrenal axis .In the present study, there was a difference in the amount of these two hormones, but it was not significant.

Testosterone ratio to cortisol

There was a significant difference in the ratio of testosterone to cortisol at different stages ($p = 0.000$). And the size of the independent variable is 0.56. That is, exercise has led to a change in the testosterone ratio to cortisol. However, there is no significant difference between the two conditions of carbohydrate supplementation and carbohydrate and protein supplementation. In addition, in examining the values of testosterone to salivary cortisol by repetitive ANOVA, the results showed no difference in the levels of testosterone to salivary cortisol in the pre-test stage, after 30 minutes and after 180 minutes from two quasi-competitive wrestles. Therefore, the effect of two complementary carbohydrate and carbohydrate-protein is similar.

Previous studies have shown that there is a negative correlation between cortisol and testosterone hormones in certain conditions (Deakin, 2004). However, these studies have never been able to clearly examine this opinion statistically. The results of the research on the effect of testosterone and cortisol on the combating sports have shown that changes in testosterone and cortisol levels are also evident in these disciplines (Azerbaijani & Nikbakht, 2002, Agha-Alinejad, 2013).

The ratio of these two hormones in this study varied, but this change was not significant due to carbohydrate and protein supplementation. Tsong (2011) conducted a study on nine wrestlers 19 years old, each wrestler participated in three matches, and the carbohydrates, carbohydrates and branched amino acids and Arginine are consumed. As long as enough carbohydrates are used for recovery, the use of amino acids does not have an effect on energy recovery. (33) In a study by Aqa Aliinejad (2013), 36 women aged 20 years who were divided into two groups within 8 weeks Strength training with intermittent or continuous monitoring of cortisol and Dehydroepiandrosterone observed that young women could use different types of strength training to improve their physical performance. (Agha-Alinejad, 2011) In Bustani's study (2013), 17 karate aged 20-year-old played one hour training with 85% peak heart rate, testosterone and Serum cortisol changed, the testosterone / cortisol ratio decreased, and testosterone and cortisol significantly decreased immediately after exercise. Serum testosterone concentrations decreased after exercise with 85% heart rate, but this was not statistically significant (Boostani et al., 2013). The reason for this conclusion and inconsistent with the result of this research can be based on the training load. In a study by Asgarpur (2015), 34 non-athlete men were 33 years old divided into three groups: Experimental group A(four training sessions), Experimental group B (three sessions per week) and control group C. Resistance training (15 sessions) based on the Cramer training

protocol which included 3 sets of 8 to 10 repetitions with 60 to 70 percent, 1 maximum repeat in the large muscle of the body. It showed that resistance training increased muscle strength, lean body mass, testosterone, and decreased cortisol and myostatin levels in both groups. This increase and decrease in experimental group A was more than that of experimental group B, and also an increase in serum levels of myostatin and cortisol in the experimental group B (Askarpur, 2015). The reason for this contradiction of the results with the present study was different training protocol.

Limoei et al. (2011) in their study on 12 female volleyball players 24 years old who performed Bruce test on Treadmill at two rotations in the morning and afternoon. Testosterone ratio to cortisol had no significant difference at two times in the morning and afternoon, but a fatigue exercise session showed a significant decrease in cortisol levels in the morning and afternoon and it can be argued that a session of exhausting exercise can not affect the level of testosterone and its ratio to serum cortisol, while it may be possible to have a significant effect and reduction the amount of cortisol. (Limoei & Hemmatfar, 2011) The contradiction of results with the current study is based on the different sex and sport fields.

In a study by Ghasemian et al. (2012) on 10 male athletes of 23 years old at the university level, the subjects were given 6 ml / kg of sport drink (experimental group) or placebo (control group), with an intensity of 81.8% of maximum heart rate (70% of maximal oxygen consumption), they ran in an experimental environment on treadmill in two sessions, 40 minutes after using sport drinks until they reached the exhausting level, while running about 15 minutes each, at a rate of 2 ml per kilogram of weight, received sport drink or placebo. Blood samples were taken to measure glucose before and immediately after exercise. They stated that in the experimental group, there was no significant difference in endurance function, activity heart rate and BGP, but the level of blood glucose from the pre-test to post-test in the experimental group was significantly increased as compared with the control group.

In the present study, there was no difference between the two types of carbohydrate and carbohydrate sport drinks.

In the Arazi and et al. (2013) Survey (2013), the subjects were 10 young men 21 years old and eight middle-aged men 49 years old. One week after determining a repeat of the maximum chest pressure, a moderate-intensity acute resistance training, four turns, 12 repetitions with an intensity of approximately 70%, one increased repetition, with a 2-minute interval between sets, were performed in both groups. Both groups experienced a significant increase in testosterone, growth hormone, Cortisol and blood lactate immediately and 30 minutes after resistance training (Arazi & Demirchi, 2014). The reason for the difference in the results of this study is the use of subjects with different age and skill levels. The Gavillio (2014) study was conducted on 22 male 28-year-old Rugby runners, who ran 3 days a week for 6 consecutive weeks, and the proportion of testosterone ratio to cortisol was higher in the mid-week rounds, and this was lower in lost games. The reason for this is physical fatigue and lack of sufficient time for proper physical and mental recovery. (Gaviglio, 2014) This finding contrasts with the findings of the present study, which is due to the difference in hormonal response to various types of exercise.

In Taheri's study (2012) on twenty 20-30-years-old men who were randomly assigned to two endurance training groups of 11 and 9 subjects in the control group. Endurance training included 30 minutes of cycling with 70% maximal heart rate in 10 weeks, which did not change the concentration of cortisol and testosterone and testosterone ratio to cortisol (Aslan et al., 1998). The contradictions in existing reports can differ in the studied groups, the methods of measurement and evaluation, intensity and duration, and the type of exercise program, the sampling time and the rest time between two treatments (Arazi & Demirchi, 2014, Aslan et al., 1998).

Conclusion

According to the results of this study, we concluded that there is no significant difference between the effect of protein carbohydrate supplementation with carbohydrate on testosterone and cortisol level.

Acknowledgments

Thanks and grateful to all those who helped me in this research.

References

1. Abdolhossein Taheri, (2012).The effect of endurance training on serum levels of pro-inflammatory cytokines, testosterone and cortisol in sedentary young men- Journal of Kermanshah University of Medical Sciences. 2012; 16 (4): 302-310-
2. Alicia Salvador, Vicente Simon, Fernando Suay, and Luis Llorens(1998). Testosterone and Cortisol Responses to Competitive Fighting in Human Males: AGGRESSIVE BEHAVIOR Volume 13, p 9-13
3. Arazi, Hamid; Demirchi, Arsalan (2014)." Comparison of Acute Hormonal Responses following strength activity with Moderate Intensity on Young and middle-aged men, Razi Journal of Medical Sciences Volume 21, Issue118, April 2014
4. Arzai, Hamid; Demirchi , Arsalan; Asadi, Abbas (2014). "Comparison of acute hormonal response following moderate to severe resistance activity in young and middle-aged men". Razi University of Medical Sciences (IUMS): Volume 21, Number 118; From page 64 to page72.
5. Askarpur, Mokhtar (2015)." The effect of two methods of resistance and non-resistance training on serum levels of myostatin, Cortisol, Testosterone and Muscle Strength of Non-athletic men"- Sport Life Sciences. Summer, 1394 Volume 7, Number 2, pages 311-328
6. Aslan, R. et al, (1998) .The effect of acute and regular exercise on antioxidative enzymes, tissue damage markers and μg by n lipid peroxidation of erythrocytes in sedentary students, TrJ Med scie.28:411-414.
7. Azerbaijani, MohammadAli ;Nikbakht Ali (2002). "The Effect of One-session of Increasing Exercise on testosterone and Cortisol in wrestlers". Research in Sport Sciences, Volume 1, Number 4; From page 101 to page 114.
8. Bell GJ et al, (2000) Effect of concurrent strength and endurance training on skeletal muscle properties and hormone contrations in humans. Eur j Appl physiol Mar27-418(5)81-
9. Biewenga j.,Thjs L.G.(1970) lactate dehydrogenate isoenzyme(s) linked to IgA immunoglobulin in patient with myocardial infraction. Clin.Chem Acta.27(2):293-299
10. Bompa, T.O. (1994) Theory and methodology of training .the Key to athletic performance(Third ed).Dubuque:Kendall/Hunt publishing company
11. Boomaveri, Fiegen ; Wieni , Scot (2010) "Strength and Power in the Young Athletes - Translation by Abbas Ali Guayini and Javad Vakili-Publications of Hatmi, Page 235-238
12. Chiman Limoei , Hemmatfar, Ahmad (2011). Comparison of the effects of exhausting exercise on serum .Summer 2011 - No. 9 – Pages33_45
13. Deakin, G.B. (2004) Concurrent training in endurance athletes: the acute effects on muscle recovery capacity, physiological, hormonal and gene expression responses post-Exercise.school of Exercise Science and sport management southern Cross university.lismore.Australia
14. Deakin,G.B. (2004) Concurrent training in endurance athletes: the acute effects on muscle recovery capacity, physiological, hormonal and gene expression responses post-Exercise.school of Exercise Science and sport management southern Cross university.lismore.Australia

15. Dunn, McLaren ; James, Morton (2012). "Sports and exercise biochemistry Sports activities" Translation: Abbas Ali Gayini. Tehran.Samt Publications. -
16. Fathi ,Farid (2012). "History of wrestling": Tehran Physical Education and Sports Science .
17. Federation of the Islamic Republic of Iran wrestling (2012) - Referee Committee of the Federation of Wrestling " Latest International Wrestling Regulations".
18. Galbo H, Richter EA, Hilsted J, Holst JJ, Christensen NJ, Henriksson, (2010). Hormonal regulation during prolonged exercise. *Ann N Y Acad Sci.* Jvol77 no 301 p72-80
19. Gaviglio (2014). Relationship Between Midweek Training Measures of Testosterone and Cortisol Concentrations and Game Outcome in Professional Rugby Union Matches- *Journal of Strength & Conditioning Research*: December 2014 – Volume 28 – Issue 12 – p 3447–3452.
20. Ghasemian Aghaali, Gaini Abbasali, Choubineh Sirous; Ghorbanian,Bohlol (2012). The Effect of Short-Term Use of a Sport Drink on Athletic Performance of Athlete-Armaghan Danesh Students. Volume 17, Number 4 (Series 70); Page 299 to page 308.
21. Hamid Agha-Alinejad,(2013). Effects of Resistance Training on Serum Cortisol and Dehydroepiandrosterone Levels in Trained Young Women- *Iranian Journal of Pathology* (2013) 8 (1), 9 - 16
22. Henning BuddeMarch, (1992) - Mechanism of general adaptation. *Med Hypotheses*vol 38 no 4 p 296-300
23. Hosseini M. (2010). Effect of Resistance and endurance trainings on salivary immunoglobulin A, cortisol and dehydroepiandrosterone concentration in untrained females. *Journal of Babol University of Medical Sciences.* , 11 (5): 38-44. [Persian]
24. J. Jurimae, A.Nurmekivi, T.Jurimae, (2004) - Hormone Responses to Intensive Interval Training in Middle-Distance Runners- *Biology of Sport*, 21 No1,
25. Jack H. Wilmur; Castell, El David. (2007)."Physiology of Exercise and Physical Activity" , Vol. I, Mobtakeran publication, pages 35-50.
26. Kiadeliri, Mazaher (1999) "Free and Far wrestling Techniques" – Vol. I-Boostan Publications. Page 60-82.
27. Kiadeliri, Mazaher (2002)."The training of the principles of the wrestling". Volume II of Bostan Publication – pages 30-45-70 to 85.
28. Kramer WJ. et al (1988)Physiological adaptation to resistance exercise. Implications for athletic Conditioning *Sport medicine*256-246:(4)6:
29. Lamir Rashid, Ganbari Niaki (2006). "Effect of Six-Week Wrestling Exercise on Plasma Lipoprotein and Hormone Level in well-trained wrestlers": Physiology Department of Exercise Physiology and Sport Sciences, Ferdowsi University of Mashhad, Iran.6th National Congress of Physical Education Students in Iran.
30. Lymouei ,Chieman ; Hemmatfar,Ahmad ;Ghofrani, Mohsen; Nouri ,parastou (2011). "Comparison of the effects of exhausting exercises on the concentration of testosterone and serum cortisol at two times in the morning and at night in female athletes", *Sports Journal of Sport Sciences*, No. 9, Summer
31. Mohammad Hassan Boostani1, Mohammad Ali Boostani1, Ebrahim Fathollahzadeh2(2013(- The acute response of testosterone, cortisol and the ratio of testosterone to- *International Journal of Wrestling Science*) vol 1 p-10
32. Moradi, Fattah (2012)."Effect of strength training on serum levels of adiponectin, testosterone and cortisol in thin and low-mobility men". *Journal of Birjand University of Medical Sciences.* 1392-pp. 125-135
33. Sajjad Zeinali, Ibrahim Salmani Nodoushan, (2012)- The Influence of One Session of Intensive Physical Activity on the Amount of Testosterone, Cortisol, Insulin And Glucose Hormone in Elite Athletes 'Blood Serum Hemostat- *Acta Kinesiologica* 6 (2012) 2: 47-51

34. Tedaye, Bawam Gartner ; Andréves Jackson (1997). "Measurement evaluation in Physical Education". Translation: Hossein Sepasy and Parivash Noorbakhsh Volume II, First Edition, Tehran Samt Publication.
35. Tsong-Rong Jang, (2011) Effects of carbohydrate, branched-chain amino acids, and arginine in recovery period on the subsequent performance in wrestlers-Journal of the International Society of Sports Nutrition.
36. Viro ,Etcó ; Viro, Mahis (2007) "Biochemistry monitoring of exercises". Gaini Translator Vol. I- Samt Publication.
37. Zeraatian nezad,Davani; Sam and colleagues (2005) "A quick guide to PAGNAN.PAGANA diagnostic methods, including ECG". Barye farda Publications , third editions, Tehran.
38. Zitzmann, M. and Nieschlag, E. (2001) - Testosterone levels in –healthy men in relation to behavioral and physical characteristics: facts and constructs. European Journal of Endocrinologyvol 144-p 183-197