The Journal of International Anatolia Sport Science©
Vol. 3, No. 1, APRIL 2018

THE EFFECTS OF MAXIMAL STRENGTH TRAINING ON SOME HEMATOLOGICAL AND BIOCHEMICAL PARAMETERS IN ELITE WRESTLERS

Serhat ÖZBAY[1]
[1]Atatürk University, Institute of Health Sciences, Erzurum, TURKEY

Abstract

Purpose: The purpose of this study is to examine the effects of maximal strength training which has a significant place in elite athletes on some hematological and biochemical parameters (creatine, eGFR calcium, phosphor, uric acid, erythrocyte, hemoglobin, hematocrit and thrombocyte). Material and Method: 16 elite wrestlers at national team level with an average age of 20 who were staying at a camp and who had the same dietary conditions participated in the study. Strength trainings were made three days a week (Monday-Wednesday-Friday) before noon. The study lasted for 8 weeks. The athletes performed the moves with an intensity of 75% and 8 repetitions in the first set, 80% intensity and 6 repetitions in the second set, 85% intensity and 4 repetitions in the third set, 90% intensity and 3 repetitions in the fourth set, and 95-100% intensity and 2 repetitions in the fifth set. Specified blood parameters were taken starting from the first maximal strength training and they were taken only before training in the last trainings of weeks 4 and 8. Specified parameters were measured through complete blood count method. Complete blood count was performed with Xn-1000, Sysmex, Japan. Descriptive statistics of all variables were presented as average± standard deviation (Ave±SD). In order to find out the effect of strength training on biochemical parameters, one-way repeated-measures ANOVA was applied on values obtained in 3 different test points (Starting, week 4, week 8). Sphericity hypothesis of repeated measures was validated by Mauchly Test. In cases where hypothesis was not validated, Greenhouse- Geisser correction was applied on degree of freedom in case of Epsilon (ε) <0.75, while Huynh-Feldt was applied in case of Epsilon (ε) >0.75. Multiple corrections were performed by applying Bonferroni correction. For the whole procedure, significance level was determined as p≤0.05 initially and SPSS 20.0 computer program was used for statistical analysis. Results: According to the results of the study, creatine values were found to differ significantly depending on the period of training (p=0,001). In addition, eGFR values were found to differ significantly depending on the period of training (p=0,001). When phosphor values were analyzed, they were found to differ significantly depending on the period of training (p=0,005). No significant difference was found in all of the calcium, uric acid, erythrocyte, hemoglobin, hematocrit, thrombocyte values depending on the period of training (p > 0.05). As a conclusion, while changes in studies conducted can be seen depending on age, gender, type of training, states of diet and rest, this study showed that maximal strength training causes some physiological changes in elite athletes.

Key words: Biochemical Parameters, Wrestling, Hematologic Parameters, Maximal Strength

INTRODUCTION

Sport has become important in today's society. Countries view sports arena as a field of cold war and develop sport policies to gain advantage over each other. This situation can cause some athletes to feel pressure and they can overload for success. In almost all branches of sports, strength trainings have an important place. When psychological reasons are taken into consideration, overloading of some athletes can be dangerous in terms of athlete health. This situation has become more interesting in terms of sport sciences and researchers have begun to analyze the effects of different intensity exercises on athlete metabolism. The data which will be put forward by studies conducted on athletes will both help a better understanding of sport and sport physiology and also help to interpret the changes which occur in the bodies of people who do sports and who are in fact healthy (Hazar & Koç, 2003).

In athletes who apply intense exercise program, Hb and Hct vales are characteristically low and this situation is considered as athlete anemia (Lindemann, 1978)

Some changes can occur in the metabolism, depending on the intensity, period and type of exercise conducted. Changes can be seen in hematologic and biochemical parameters during high intensity exercise. These changes can also differ following exercise or at the end of the continuing training program, in terms of the individual's gender, training state, age, environmental factors and diet. Some changes can be observed in athletes based on long-term high intensity exercise.

Physical activity is an important function of life system. In addition to influencing a great number of systems, it can also influence biochemical parameters (Öztürk et al. 2012).

Literature review shows specific studies about parameters examined in our study. However, eGFR parameter and other parameters have not been studied as the training applied in the study method. It is thought that the present study will contribute to both elite athletes, trainers and also to sport sciences literature since both the group studied is an elite group and because of the difference in study method.

MATERIAL AND METHOD

16 elite wrestlers at national team level with an average age of 20 who were staying at a camp and who had the same dietary conditions chosen among wrestlers who had degrees in European and World Championships and who had represented Turkey in Rio Olympics participated in the study. Before the study was conducted, the participants were informed about the program and care was taken for the athletes to be volunteers. In this study, to find out 1TM, each athlete's maximal strength was found for each move planned in the strength training program while the athletes were in resting position before the strength training started. Strength trainings were made three days a week (Monday-Wednesday-Friday) before noon. The training program applied on the athletes was as follows. The athletes performed the moves with an intensity of 75% and 8 repetitions in the first

set, 80% intensity and 6 repetitions in the second set, 85% intensity and 4 repetitions in the third set, 90% intensity and 3 repetitions in the fourth set, and 95-100% intensity and 2 repetitions in the fifth set. The moves in the training program were Shoulder Press (shoulder), Bench Press (chest), Lat Pull (back), Squat (half), Butter Fly (chest), Barbell Curl (forearm), jerk (lifting), Leg Curl (back upper calf). The study lasted for 8 weeks. Specified blood parameters were taken starting from the first maximal strength training and they were taken only before training in the last trainings of weeks 4 and 8. Specified parameters were measured through complete blood count method. Complete blood count was performed with Xn-1000, Sysmex, Japan.

Data Analysis

Descriptive statistics of all variables were presented as average± standard deviation (Ave±SD). In order to find out the effect of strength training on biochemical parameters, one-way repeated-measures ANOVA was applied on values obtained in 3 different test points (Starting, week 4, week 8). Sphericity hypothesis of repeated measures was validated by Mauchly Test. In cases where hypothesis was not validated, Greenhouse- Geisser correction was applied on degree of freedom in case of Epsilon (ε) <0.75, while Huynh- Feldt was applied in case of Epsilon (ε) >0.75. Multiple corrections were performed by applying Bonferroni correction. For the whole procedure, significance level was determined as $p \leq 0.05$ initially and SPSS 20.0 computer program was used for statistical analysis.

RESULTS

Table 1. Participants' Descriptive Statistics (Starting point)

	Min	Max	Ave	SD
Age (years)	17	27	20,56	4,06
BW (kg)	53,5	99,9	74,34	12,02
Height (cm)	161	181	172,69	7,51

Table 2 gives some of the biochemical and hematologic blood parameters in 8-week-long training period.

Table 2. Biochemical and Hematologıcal Parameters Values during 8-week-long training period

Biochemical Hematologıcal Parameters	Starting point Ave ± Sd	Week 4 Ave ± Sd	Week 8 Ave ± Sd	F	P
Creatine (mg/dl)	0,93 ± 0,13	0,99 ± 0,13	1,01 ± 0,18	9,038	**0,001**
eGFR (mg/dl)	111,22 ± 6,92	106,14 ± 17,34	104,63 ± 8,30	8,883	**0,001**
Calcium (mg/dl)	9,98 ± 0,43	9,82 ± 0,33	9,71 ± 0,35	3,278	0,070
Phosphor (mg/dl)	3,70 ± 0,63	4,03 ± 0,62	4,18 ± 0,67	6,248	**0,005**
Uric acid (mg/dl)	5,93 ± 0,58	5,57 ± 0,83	6,03 ± 0,98	2,598	0,091
Erythrocyte (/µl)	5,41 ± 0,34	5,30 ± 0,38	5,29 ± 0,72	0,643	0,470
Hemoglobin (g/dl)	15,25 ± 0,84	15,01 ± 0,89	15,46 ± 1,05	3,505	0,650
Hematocrit (%)	45,89 ± 2,31	45,24 ± 2,08	45,88 ± 2,74	0,926	0,407
Thrombocyte (/µl)	247,19±55,01	239,38 ± 53,41	240,75 ± 56,82	0,832	0,445

Table 2 gives the values of some biochemical parameters before training period started, on week 4 and on week 8 (after training).

According to these results, creatine values were found to differ significantly depending on the period of training (F=9,038; p=0,001). Since the results were found to be significant, multiple comparisons were analyzed with Bonferroni Post-Hoc test to find out between which measurement times there were differences. According to the results of this analysis, the values were found to differ significantly between 1-2 (p=0,003) (starting point – week 4) and between 1-3 (p=0,003) (starting point – week 8).

In addition, eGFR values were found to differ significantly depending on the period of training (F=8,883; p=0,001). Since the results were found to be significant, multiple comparisons were analyzed with Bonferroni Post-Hoc test to find out between which measurement times there were differences. According to the results of this analysis, the values were found to differ significantly between 1-2 (p=0,007) and 1-3 (p=0,002).

Calcium values were not found to differ significantly depending on the period of training (F=3,278; p=0,070).

When phosphor values were examined, they were found to differ significantly depending on the period of training (F=6,248; p=0,005). Since the results were found to be significant, multiple comparisons were analyzed with Bonferroni Post-Hoc test to find out between which measurement times there were differences. According to the results of this analysis, the values were found to differ significantly between only 1-3 (p=0,006).

Uric acid values were not found to differ significantly depending on the period of training (F=2,598; p=0,091).

In addition to these, no significant differences were found in Erythrocyte (F=0,643; p=0,470), Hemoglobin (F=3,505; p=0,650), Hematocrit (F=0,926; p=0,407) and Thrombocyte (F=0,832; p=0,445) values.

DISCUSSION AND CONCLUSION

The purpose of the study was to find out the effects of 8-week-long maximal strength trainings on creatine, eGFR, calcium, phosphor, uric acid, erythrocyte, hemoglobin, hematocrit and thrombocyte parameters of elite athletes and the results showed significant difference between creatine and eGFR values which are related with kidney functions. In addition, while significant difference was found in phosphor values, no significant difference was found in calcium, uric acid, erythrocyte, hemoglobin, hematocrit and thrombocyte values.

When the results of the study were examined in the light of literature, no significant difference was found between creatine values of groups in a study in which 12-week-long different training methods were applied on 3 different groups. In the same study in which different aerobic trainings were applied, the results of the study showed significant increases in urea and uric acid levels and significant decreases in the phosphor concentrations of the interval running group. No significant change was observed in any of the training groups in terms of creatine (Çevik et al. 1996). These results are not in parallel with the results of our study. It is thought that the difference in results can be due to the content of the training program and the characteristics of the study group. When different studies are examined, no significant differences were found in thrombocyte counts following the 60-minute 60% max VO2 acute exercise conducted on 28-year-old sedentary males (Özdengil, 1998). This result is in parallel with the results of our study. A weight program and biochemical tests were conducted on 10 bodybuilders and 10 sedentary. In the study, differences were found in the creatine levels of sedentary and body builders (Vincent & Vincent, 1997). These results are in parallel with the results of our study. Similarly, as a result of chronic exercise applied on sedentary subjects, no significant differences were found in thrombocyte (Büyükyazı & Turgay, 2000). In a study conducted on a total of 11 Olympic athletes, 7 males and 4 females, participants' blood parameters were analyzed at high altitude at the end of the season and while significant results were found only in hemoglobin, erythrocyte and hematocrit levels, no significant difference was found in thrombocyte level (Rietjens et al. 2002). In another study model in which 4-week-long intensive training was applied following a 2-week-long normal training, rhythmical and insignificant decreases were found in the first, second and third weeks in erythrocyte and hemoglobin values, while regular and significant increases were found in fourth, fifth and sixth weeks (Halson et al. 2003). These results were not in parallel with the results of our study. It is thought that this was due to the type of training and altitude. In 20-day-long study conducted on 25 people, no significant result was found in hemoglobin and hematocrit levels (Mashiko, 2004). This result was in parallel with the results of our study. In another study conducted on football players, a significant increase was found in erythrocyte values following acute exercise (Çelik et al. 2007). In a study conducted to find out the effects of 8-week-long continuous and interval running programs on creatine and urea levels, the exercise program was not found to cause significant change in urea levels. It is thought that the insignificant change in urea level is caused by urea to be excreted during exercise and to be let out with urine following the exercise (Koç et al. 2007). In a 4-week-long study conducted on taekwondo athletes, while no significant difference was found in thrombocyte, hemoglobin and hematocrit values, significant difference was found in erythrocyte values (Çakmakçı, 2009). In another study which examined the thrombocyte, hematocrit, hemoglobin, erythrocyte and creatine levels of different groups, while no significant difference was found in thrombocyte, hematocrit, hemoglobin and erythrocyte values, creatine levels of wrestlers were found to be significantly different than the values of other groups (Kara et al. 2010). These results are in parallel with the results of our study. In an 8-week-long study conducted on university students, differences were found in erythrocyte values, while no significant difference was found in hematocrit, hemoglobin and thrombocyte values (Şarvan & Cinar, 2014). In another study in which different strength training programs were applied, no significant difference was found in erythrocyte and thrombocyte values of the participants (Kayhan, 2014). The results of this study, the methods of which resembled our study the most, were in parallel with the results of our study. In another study conducted to find out the effects of anaerobic extensive and intensive interval training performed for 7 weeks with different resting intervals and the same intensity on aerobic and anaerobic capacity and blood parameters, partial changes were found in hemoglobin values in addition to significant changes in hematocrit values (Demiriz et al. 2015).

In the present study, while 8-week-long maximal intensity strength trainings caused significant changes on creatine, eGFR and phosphor parameters, it was not found to cause significant changes on thrombocyte, hemoglobin, hematocrit, calcium and erythrocyte values. It is thought that the significant changes in eGFR caused by the decrease in creatine can be caused by the increase in athletes' muscle mass, excessive protein diet or due to fatigue as a result of not getting enough rest during maximal strength trainings. The increase in phosphor rate is thought to occur as a result of response to tissue damage that may occur due to maximal strength trainings. While it is thought elite athletes, trainers and sport science experts will benefit from our study, the association between the parameters used in our study, especially creatine, eGFR and phosphor and exercise, muscle and tissue damage should be examined with further studies.

REFERENCES

Büyükyazı, G., & Turgay, F. (2000). Sürekli ve yaygın interval koşu egzersizlerinin bazı hematolojik parametreler üzerine akut ve kronik etkileri. *ve tek. Yüksekokulu VI. Spor Araştırmaları Kongresi Bildiri, Ankara*, *182*.

Cengiz, Ş. Ş., & Çinar, V. (2014). The Effect of 8-Week Core Exercises on Some Hematological Parameters in Sedentary Females. Turkish Journal of Scientific Research. Vol, 1(1), 1-5.

Çakmakcı, E. (2009). Erkek taekwondocularda kamp döneminin bazı hematolojik parametreler üzerine etkileri. *Niğde Üniversitesi Beden Eğitimi ve Spor Bilimleri Dergisi Cilt 3, Sayı 1*.

Çelik, A., Varol, R., Onat, T., Dağdelen, Y., & Tugay, F. (2007). Akut egzersizin futbolcularda antioksidan sistem parametrelerine etkisi. *Spormetre Beden Eğitimi ve Spor Bilimleri Dergisi*, *4*, 167-172.

Çevik, C., Günay, M., Tamer, K., Sezen, M., & Onay, M. (1996). Farklı aerobik nitelikli antrenmanların serum enzimler, serum elektrolitler, üre, kreatin, total protein, fosfor ve ürik asit üzerindeki etkileri ve ilişki düzeylerinin belirlenmesi. *Gazi Üniversitesi Beden Eğitimi ve Spor Bilimleri Dergisi*, *1*(2), 37-46.

Demiriz, M., Erdemir, İ., & Kayhan, R. F. (2015). Farklı dinlenme aralıklarında yapılan anaerobik interval antrenmanın, aerobik kapasite, anaerobik eşik ve kan parametreleri üzerine etkileri. *International Journal of Sport, Exercise & Training Sciences*, *1*(1), 1-8.

Halson, S. L., Lancaster, G. I., Jeukendrup, A. E., & Gleeson, M. (2003). Immunological responses to overreaching in cyclists. *Medicine and Science in Sports and Exercise*, *35*(5), 854-861.

Hazar, S., & Koç, H. (2003). Türk güreş milli takımı seviyesindeki güreşçilerin kalp yapı ve fonksiyonlarının elektrokardiografi yöntemiyle incelenmesi. *Gazi Beden Eğitimi ve Spor Bilimleri Dergisi*, 3.

Kara, E., Özal, M., & Yavuz, H. U. (2010). Elit güreşçi ve basketbolcuların kan ve solunum parametrelerinin karşılaştırılması. *Selçuk Üniversitesi Beden Eğitimi ve Spor Bilim Dergisi*, *12*(1), 36-41.

Kayhan, R. F. (2014). Farklı kuvvet antrenmanlarının kreatin kinaz enzim aktivitesi ve kan parametrelerine etkisi. Balıkesir Üniversitesi sağlık Bilimleri Enstitüsü Beden Eğitimi ve Spor Anabilim Dalı Yüksek Lisans Tezi.

Koç, H., Tamer, K., & Çoksevim, B. (2007). Devamlı ve aralı (interval) koşu programlarının plazma üre ve kreatin düzeyleri üzerine etkisi. *Sağlık Bilimleri Dergisi*, *16*(1), 17-22.

Lindemann, R. (1978). Low hematocrıts durıng basıc traınıng-athletes anemıa. *New England Journal of Medicine*, *299*(21), 1191-1192.

Mashiko, T., Umeda, T., Nakaji, S., & Sugawara, K. (2004). Effects of exercise on the physical condition of college rugby players during summer training camp. *British journal of sports medicine*, *38*(2), 186-190.

Özdengül, F. (1998). Akut submaksimal egzersizin immun sisteme etkileri. *Doktora Tezi Selçuk Üniversitesi. Sağlık Bilimleri Enstitüsü*.

Öztürk, Ç., Çumralıgil, B., & Çakmakçı, O. (2012). Sporcularda ve sedanter bireylerde akut egzersiz öncesi gliserol takviyesinin laktat ve maxvo2 üzerine etkileri. *Beden Egitimi ve Spor Bilimleri Dergisi*, *6*(1).

Rietjens, G.J., Kuipers, H., Hartgens, F., & Keizer, H.A. (2002). Red Blood Cell Profile of Elite Olympic Distance Triathletes. A thre–year follow–up. *International journal of sports medicine*, *23*(06), 391-396.

Vincent, H. K., & Vincent, K. R. (1997). The effect of training status on the serum creatine kinase response, soreness and muscle function following resistance exercise. *International journal of sports medicine*, *28*(06), 431-437.