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Mehmet Ali Öztürk

Ramazan Erdoğan

Tunç İlçin

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[1]Bitlis Eren University School of Physical Education and Sport, Bitlis, Turkey

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Effects of Long Term Volleyball Training on Mineral Metabolism and Hematological Parameters

Mehmet Ali Öztürk, Ramazan Erdoğan, Tunç İlçin
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ABSTRACT
Objective: Following acute exercises, changes in mineral and hematological concentrations are observed in the organism depending on the exercise, but regular and submaximal exercises do not fully reveal the mineral and hematological effects. This study was conducted to determine the effects of volleyball training on mineral metabolism and hematological parameters over a period of three months.
Method: The research group included 20 healthy male volunteers in the 13-16 age group. A training program of 80 minutes per day, 4 days per week, for three months was applied to the athletes who participated in the study. Blood samples were taken twice before and at the end of the training sessions from the resting athletes. Sodium, potassium, chlorine, calcium, magnesium, WBC, RBC, HGB, HCT, MCV, MCH, MCHC, PLT, MPV and PDW levels were determined in the blood samples collected. The data were analyzed using the SPSS 22 package program. The Paired Samples t-test was used to compare the research group's pre-final test data. Significance was considered to be $p>0.05$.
Finding: The analysis showed that the research group had statistically significant differences in sodium, chlorine, phosphorus, magnesium, RBC, HCT, MCV, MCH, MCHC, MPV and PCT levels ($p<0.05$) and no statistically significant differences in potassium, calcium, WBC, HGB, PLT, RDW-CV and PDW levels ($p>0.05$).
Conclusion: As a result, volleyball training over a long period of time has been observed to cause changes in mineral metabolism and some hematological parameters. It was found that the regular training schedule caused differences in some mineral and whole blood values. In the light of this information, we believe that long-term adolescent training will have a positive impact on the health of athletes.

Keywords: Hemogram, Volleyball, Mineral Metabolism, Training,

INRODUCTION

There are many sports disciplines in which athletic performance generally depends on aerobic and anaerobic capacity. They are characterized by high intensity intermittent exercise in many sports as well as disciplines involving short-term high intensity single supramaximal exercise. These are individual and team sports which repetitive sprinting ability and performance are important. Both types of exercise cause acid-base balance distortion and fatigue in the skeletal muscle. In addition to the complex factors that cause fatigue in the body, both central and environmental factors are effective [1,2,3].

As a result of these physiological changes occurring in the body, there are changes in hematological parameters, mineral and element metabolism that have important functions in athletic performance. Minerals and elements are important components of normal physiological behavior of the body as well as important tasks for adaptation to exercise. Minerals and elements are inorganic micronutrients found in a variety of plant and animal foods [4,5]. It is related to exercise and athletic performance, such as micronutrients, energy storage / use, protein metabolism, inflammation, oxygen transport, heart rhythms, bone metabolism, and immune function, involving hundreds of biological processes. In addition to exercise, changes in body, mineral or element level and hematological parameters can lead to cardiovascular disorders, hematological changes and decreased athletic performance [6].

Another interesting finding that can be seen in the body together with exercise is hemoconcentration. This can be seen when blood fluid is filtered into the interstitial space due to increased vascular osmolality, increased arterial pressure and sympathetic activation. Hemoconcentration is a plasma loss indicator. Plasma loss seen as a result of exercise is one of the factors that causes renal hypoperfusion, but hemoconcentration can affect certain biochemical parameters and athletic performance [7]. It is therefore important to determine the effect of exercise on plasma volume and bio-markers [8].

In any event, information on the chronic effect of long-term exercise programs on hematological parameters, mineral and element metabolism is limited and more current research is needed in this area. In this context, the effect of long-term volleyball training on certain minarels and hematological parameters has been determined.

MATERIAL AND METHOD

Study Group

The research group consisted of 24 licensed male athletes who were between 13 and 16 years old and regularly attended volleyball training. The effect of long-term and regular training on the mineral and hematological parameters of athletes was identified in the scope of the research.

Training Program

The research group underwent a training program of four days a week and eighty minutes a day, including training for fitness one day a week for three months, taking into account volleyball competitions. In the each training unit, 50-60 minutes of competition and physical exercises were performed after 15-20 minutes of warm-up time and 5 minutes of cooling-off exercises were performed in the final phase of the training. The training was adjusted to the maximum heart rate intensity of 65-70 % according to the condition level of the study group using the karvonen method.

Collection and Analysis of the Samples

Blood samples were taken twice, before and after the training sessions from the athletes in sitting position. Athletes who participated in the study were observed during training sessions, and athletes who had metabolic disorders or had been on medication were excluded from the study. As a result, the research was completed with 20 athletes. Sodium, potassium, chlorine, calcium, magnesium, WBC, RBC, HGB, HCT, MCV, MCH, MCHC, PLT, MPV and PDW levels have been determined in blood samples taken as a result of training. Blood samples from athletes were analyzed in a private hospital laboratory using a auto-analyzer.

Statistical Analysis

The data collected was analyzed using the SPSS 22.0 package program. The Shapiro Wilk test was performed for the data normality test. Paired Samples t-test was performed to compare the research group's pre-final test data. The level of significance was taken as $p<0.05$.

RESULTS

Table 1: Mineral values of study group

Parameters	Pre-Training	After Training	t	p
Sodium	143.40 ±2.84	145.33 ±3.06	-2.71	0.01*
Potassium	4.73 ±0.34	4.81 ±0.35	-1.37	0.19
Chlorine	108.20 ±2.17	109.40 ±1.59	-2.24	0.04*
Calcium	9.58±0.35	9.66±0.27	-1.03	0.31
Phosphorus	4.77±0.27	4.48±0.45	2.95	0.01*
Magnesium	2.03±0.18	2.22±0.23	-2.91	0.01*

*(p<0,05)

According to the mineral level of the athletes participating in the study, the examination of Table 1 showed there were statistically differences in sodium, chlorine, phosphorus and magnesium levels ($p<0.05$), and there were no statistically differences in calcium and potassium levels ($p>0.05$).

Table 2: Hematologic parameter values of the study group

Parameters	Pre-Training	After Training	t	p
Leukocyte				
WBC	5.25 ±1.46	5.77 ±1.67	-1.19	0.25
Erythrocyte				
RBC	5.18 ±0.54	4.77±0.24	2.63	0.02*
HGB	14 ±0.90	13.88 ±0.54	0.58	0.57
HCT	42.81 ±3.06	41.29±1.54	2.13	0.05*
MCV	83.38±6,73	86.94 ±3,97	-2.19	0.04*
MCH	27.08±2,21	29.11 ±1,56	-3.12	0.00*
MCHC	32.60 ±0.87	33.56 ±0,53	-3.65	0.00*
RDW-CV	13.62 ±1,19	14.06 ±1,16	-1.24	0.23
Thrombocyte				
PLT	280.27 ±63.18	262.67 ±37,40	1.08	0.29
MPV	9.36 ±0.70	7.98±1.35	4.44	0.00*
PDW	41.04 ±5.71	40.13 ±3.99	0.81	0.43
PCT	0.26 ±0.05	0.21 ±0,04	2.26	0.04*

When Table 2 was examined and the hematological parameters of the athletes participating in the study were evaluated, while there were no differences in WBC, HGB, PLT, RDW-CV and PDW levels ($p>0.05$), RBC, HCT, MCV, MCH, MCHC, MPV and PCT levels were found to be statistically different ($p<0.05$).

DISCUSSION AND CONCLUSIONS

The effect of long-term and regular exercise programs on mineral and hematological parameters is known, but how it affects the performance of athletes is important. In this study, taking into account all of these factors, the effect of long-term volleyball training on the mineral metabolism and hematological parameters of athletes was examined.

The study found that there were statistical differences in sodium, chlorine, phosphorus and magnesium levels when the athlete's mineral values were examined before and after training, while there were no statistical differences in calcium and potassium levels. As a result of the training, the mineral levels of the athletes were seen to increase overall. In a similar study, Karakukcu et al., (2013) found that there were variations in the element levels of athletes in the study who underwent an eight-week exercise program [9]. In a study involving eighteen athletes, Soria et al. (2016) found that changes in hormone and element metabolism occur after an acute exercise [10]. In a different study, Kaplan and Ocal (2018) found that athletes in the study who actively practiced an acute swimming exercise to participants engaged in the sport of swimming had a decrease in sodium and chlorine levels and an increase in potassium levels [11]. Gülnar and Ünsal (2018) found that in the study of ten male sedentary individuals, potassium, sodium, phosphorus, sulfur, magnesium, calcium, iron, zinc, manganese and nickel mineral levels did not affect much after an acute exercise performed up to fatigue [12]. In a study involving twenty-one athletes, Ugras (2017) stated that high intensity training affects athletes ' mineral levels [13]. In ano ther study involving twenty-seven male athletes, González-Haro et al. (2011) noted that there was no change in the element levels of athletes after an acute exercise. The results obtained in the research show similarity to previous studies and they support our research results. In the study, we believe that differences in mineral metabolism are an indicator of the duration and intensity of the exercise.

The analysis showed that the research group had statistically significant differences in sodium, chlorine, phosphorus, magnesium, RBC, HCT, MCV, MCH, MCHC, MPV and PCT levels ($p<0.05$) and no statistically significant differences in potassium, calcium, WBC, HGB, PLT, RDW-CV and PDW levels. It was observed that there were changes in the hematological parameters of athletes as a result of the training program applied. In a similar study conducted in the research group involving twenty-four basketball players, Dzedzej et al., (2016) determined that seasonal training and competitions constitute variations in the hematological parameters of athletes [15]. Siquier-Coll et al., (2019) indicated changes in mineral and erythrocyte levels after an acute exercise performed at different temperatures [16]. In the study involving ten male university students, Kasap et

al., (2018) found that a two-week exercise program resulted in variations on students ' hematological parameters [17]. In the study of eight weeks of aerobic exercise program in obese and overweight individuals, Çakmakçı et al. (2010) found that the participants had variations in hematological parameters, and as a result of the research, acute and intense exercises had more impact on hematological parameters than chronic and low intensity exercises [18]. Skarpańska-Stejnborn et al., (2015) found that an intensive exercise program implemented in the study involving twenty elite rowing athletes caused changes in the athletes ' hematological parameters [19]. In another study, Nishiie-Yano et al., (2019) found that regular judo training creates significant changes in athletes ' hematological parameters [20]. In a different study, Selçuk et al. (2018) determined that the ten-day intensive exercise program they administered constituted changes in some hematological values of tennis players [21]. Demiriz et al. (2015) applied a seven-week training program by separating the participants into extensive and intensive training groups and they determined that changes in blood parameters were observed and that the group of ectensive training positively influenced VO2 and anaerobic capacity with the applications performed [22]. In the study of thirty-one elite sports elite athletes participated, Bauer et al. (2018) found that an acute exercise program causes changes in the hematological parameters of athletes [23]. In a different study conducted with the participation of seventy-six athletes, Moulongo et al., (2019) have found that marathon racing creates changes in the hematological values of athletes [24]. The findings obtained in the research are generally supported by the literature. In this context, we believe that these changes in hematological parameters are caused by the effect of low-intensity and long-term exercises on the body.

As a consequence, regular exercises seemed to significantly affect some of the hematological parameters and mineral metabolism of volleyball players. As a result of submaximum exercises, increased levels of sodium, chlorine, magnesium, calcium, potassium, WBC, HGB, PLT, RDW-CV, MPV, HCT, MCV, MCH and MCHC, phosphorus, RBC, HGB, HCT, PLT, MPV, PDW drops and PCT levels have been determined. In comparison with previous studies, some hematological parameters of submaximal exercises in volleyball players according to acute and high intensity exercises and it is believed that it can affect mineral metabolism at a lesser level.

REFERENCES

1. Alis, R., Sanchis-Gomar, F., Primo-Carrau, C., Lozano-Calve, S., Dipalo, M., Aloe, R., and Lippi, G. (2015). Hemoconcentration induced by exercise: Revisiting the D ill and C ostill equation. Scandinavian journal of medicine & science in sports, 25(6), e630-e637.
2. Bauer, P., Zeissler, S., Walscheid, R., Frech, T., and Hillebrecht, A. (2018). Acute effects of high-intensity exercise on hematological and iron metabolic parameters in elite male and female dragon boating athletes. The Physician and sportsmedicine, 46(3), 335-341.
3. Cakmakci, E., Sanioglu, A., Vatansev, H., and Marakoglu, K. (2010). The Effects Of 8-Week Step-Aerobıc Exercıse On The Body Composıtıon And Hematologıc Parameters In The Obese And Overweıght Females. Ovidius University Annals, Series Physical Education & Sport/Science, Movement & Health, 10(2).
4. Chycki, J., Golas, A., Halz, M., Maszczyk, A., Toborek, M., and Zajac, A. (2018). Chronic ingestion of sodium and potassium bicarbonate, with potassium, magnesium and calcium citrate improves anaerobic performance in elite soccer players. Nutrients, 10(11), 1610.
5. Demiriz, M., Erdemir, İ., and Kayhan, R. F. (2015). Farklı Dinlenme Aralıklarında Yapılan Anaerobik İnterval Antrenmanın, Aerobik Kapasite, Anaerobik Eşik ve Kan Parametreleri Üzerine Etkileri. Uluslararası Spor Egzersiz ve Antrenman Bilimi Dergisi, 1(1), 1-8.
6. Driller, M. W., Gregory, J. R., Williams, A. D., and Fell, J. W. (2012). The effects of serial and acute NaHCO3 loading in well-trained cyclists. The Journal of Strength & Conditioning Research, 26(10), 2791-2797.
7. Dzedzej, A., Ignatiuk, W., Jaworska, J., Grzywacz, T., Lipińska, P., Antosiewicz, J., ... and Ziemann, E. (2016). The effect of the competitive season in professional basketball on inflammation and iron metabolism. Biology of sport, 33(3), 223.
8. González-Haro, C., Soria, M., López-Colón, J. L., Llorente, M. T., and Escanero, J. F. (2011). Plasma trace elements levels are not altered by submaximal exercise intensities in well-trained endurance euhydrated athletes. Journal of Trace Elements in Medicine and Biology, 25, S54-S58.
9. Gupta, U. C., and Gupta, S. C. (2014). Sources and deficiency diseases of mineral nutrients in human health and nutrition: a review. Pedosphere, 24(1), 13-38.
10. Gülnar, U., and Ünsal, S. (2018). Yorgunluğa Kadar Yaptırılan Gündüz Egzersizinin Element Metabolizması Üzerine Etkisi. Genel Tip Dergisi, 28(3), 107-112.
11. Heffernan, S. M., Horner, K., De Vito, G., and Conway, G. E. (2019). The role of mineral and trace element supplementation in exercise and athletic performance: A systematic review. Nutrients, 11(3), 696.

12. Kaplan, D. Ö., and Öcal, D. (2018). Yüzücülerde Antrenman Sonucu Oluşan Dehidrasyonun Kan Parametreleri Üzerine Etkisinin Araştırılması. CBÜ Beden Eğitimi ve Spor Bilimleri Dergisi, 13(1), 136-150.
13. Karakukcu, C., Polat, Y., Torun, Y. A., and Pac, A. K. (2013). The effects of acute and regular exercise on calcium, phosphorus and trace elements in young amateur boxers. Clin Lab, 59(5-6), 557-562.
14. Kasap, M., Erdemir, İ., and Kayhan, R. F. (2018). Direnç Egzersizleri Sırasında Su Alımının Hemogram Üzerindeki Akut Etkisi. Spormetre Beden Eğitimi ve Spor Bilimleri Dergisi, 16(4), 151-157.
15. Maynar, M., Bartolomé, I., Alves, J., Barrientos, G., Grijota, F. J., Robles, M. C., and Muñoz, D. (2019). Influence of a 6-month physical training program on serum and urinary concentrations of trace metals in middle distance elite runners. Journal of the International Society of Sports Nutrition, 16(1), 53.
16. Moulongo, J. G. A., Massamba, E. L. S., Moussoki, J. M., Ndalla, M. C., Moussitou, D. P., On'esala, J. N. G., and Massamba, A. (2019). Haematological Changes of Half-Marathon Runners in the Sub-Saharan African Environment. Journal of Biosciences and Medicines, 7(09), 96.
17. Nishiie-Yano, R., Hirayama, S., Tamura, M., Kanemochi, T., Ueno, T., Hirayama, A., and Miida, T. (2019). Hemolysis Is Responsible for Elevation of Serum Iron Concentration After Regular Exercises in Judo Athletes. Biological Trace Element Research, 1-7.
18. Selcuk, M., Cinar, V., Sarikaya, M., and Oner, S. (2018). Reviewing the Effect of 10 Days of Intense Exercise Period on Certain Blood Parameters of Tennis Players. Journal of Education and Training Studies, 6(11), 95-98.
19. Siquier-Coll, J., Bartolomé, I., Perez-Quintero, M., Grijota, F. J., Arroyo, J., Muñoz, D., and Maynar-Mariño, M. (2019). Serum, Erythrocyte And Urinary Concentrations Of İron, Copper, Selenium And Zinc Do Not Change During An İncremental Test To Exhaustion İn Either Normothermic Or Hyperthermic Conditions. Journal of Thermal Biology, 86, 102425.
20. Skarpańska-Stejnborn, A., Basta, P., Trzeciak, J., and Szcześniak-Pilaczyńska, Ł. (2015). Effect of intense physical exercise on hepcidin levels and selected parameters of iron metabolism in rowing athletes. European journal of applied physiology, 115(2), 345-351.
21. Soria, M., Anson, M., and Escanero, J. F. (2016). Correlation analysis of exercise-induced changes in plasma trace element and hormone levels during incremental exercise in well-trained athletes. Biological trace element research, 170(1), 55-64.
22. Ugras, A. (2017). Effect of High Intensity Interval Training on Muay Thai Athletes' mineral levels. The Anthropologist, 27(1-3), 125-133.
23. Wołyniec, W., Kasprowicz, K., Rita-Tkachenko, P., Renke, M., and Ratkowski, W. (2019). Biochemical Markers of Renal Hypoperfusion, Hemoconcentration, and Proteinuria after Extreme Physical Exercise. Medicina, 55(5), 154.
24. Zajac, A., Cholewa, J., Poprzecki, S., Waskiewicz, Z., and Langfort, J. (2009). Effects of sodium bicarbonate ingestion on swim performance in youth athletes. Journal of sports science & medicine, 8(1), 45.