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THE CHANGES OF SERUM MAGNESIUM ON NANO SCALE AFTER AN EXHAUSTION EXERCISE IN MALE STUDENTS

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The purpose of this research is to study serum magnesium (Mg) alternation in male athletes, according to the scale of nanogram per micro liter. A microscopic alternation, even in nanogram per micro liter scale, in some mineral elements results in extensive alternations in some bodily functions and athletes' performance. To this end, twelve male athletes participated in this research. The researchers took blood samples from the athletes in three different stages. The first stage was in a fasting mode at eight o'clock in the morning. After the first stage, subjects performed Balke's 15-minute aerobic run to the point of exhaustion. The traversed distance was measured and recorded by the researchers. In the second stage, blood samples were taken immediately after the run and in the third stage, after 24 hours of rest. The comparison of the means of serum magnesium concentration in blood between the first and second stages resulted in a significant difference (P = 0.003). There was no significant difference between the means of the first and third stages (P = 0.239), and the comparison between means of the second and third stages also resulted in a significant difference (P = 0.0001).The results indicate that physical exercise to the point of exhaustion leads to an increase in serum magnesium concentration in men. However, 24 hours of relaxation can return the concentration of serum magnesium to its normal mode.

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1. Introduction

Magnesium (Mg), a cofactor in >300 enzymatic reactions in cells, plays a fundamental role in energy metabolism [1]. Mg is essential to many reactions, including glycogen breakdown, fat oxidation, protein synthesis, and adenosine triphosphatase (ATP) synthesis, particularly important during physical activity. Mg also serves as a physiologic regulator of membrane stability and is important in neuromuscular and cardiovascular function [2, 3].

Magnesium is also involved in cellular energy production, glycogen breakdown, protein synthesis, cell growth, calcium balance, the N-methyl-Daspartate ion channel antagonist, and modulation of the activity of adenosine triphosphatase providing energy for muscles and the brain. In addition, magnesium serves as a physiological regulator of cellular membrane stability, and of the neuromuscular, cardiovascular, hormonal, immune, and central nervous systems [4, 5].

In human body, many trace elements take part in numerous physiological and biochemical events [6]. The changes in the element levels changes depending on the type, length and intensity of the exercise, as well as the nutritional behavior [7]. In parallel to the factors mentioned above, the changes at the levels of the trace elements inevitably affect the performance in athletes as well. In recent years, relationships between the type of the nutrition in the athletes and the performance in sports have begun to be researched extensively [8, 9]. In exercises performed at top levels, the trace element intake is affected [10]. Intake of energy into the body is also related to a great extent with the magnesium, phosphorus, iron, the vitamins and Vo_{2max} [11].

Accumulating evidence has shown a direct relationship between magnesium and exercise performance. Some studies have reported that serum or plasma magnesium concentration was decreased after exercise [12, 13].

A positive relation between magnesium levels and physical performance was recently established [14, 15]. Magnesium insufficiency has been shown to decrease physical performance [16]. In a study involving training athletes, Stendig-Lindberg et al. found that plasma Mg levels increased by 13–16% just after exercise but decreased to lower than normal values after 24 h [17]. Magnesium requirement increases during exercise. The daily magnesium need of high performance athletes is estimated to be about 548 mg [18, 19]. The changes in serum or plasma magnesium levels are closely related to exercise type [19, 20]. In general, the magnesium level increases with exhaustion in high-intensity, short-time exercises but decreases with exhaustion in intense, long-time exercises [21, 19]. It has been shown that magnesium may be lost in sweat [22].

The aim of this research is to study alterations in the concentration of blood serum magnesium of athletes. Different physical activities and exercises can generate different responses in the concentration of serum magnesium. For this reason, there are still many ambiguities in this regard.

2. Methodology

Twelve male athletes participated in a semi-experimental research. The participants filled out forms that showed they are in perfect health. They were committed not to use any medicine or nutritional supplements. The purpose of the research was explained to them. The participants' means of weigh, height, age, body mass index (BMI) and maximal oxygen consumption (Vo_{2max}) were (72.22 ± 2.22), (175.03 ± 4.1), (21.12 ± 3.14), (23.2 ± 3.31) and (55.34 ± 2.39) respectively (table 1).

Table 1. Physical characteristics of the subjects in exercise day.

Variables	Mean	Standard Deviation
Weight (Kg)	72.22	2.22
Height(Cm)	175.03	4.1
Age(Yr)	21.12	3.14
BMI(Cm^2)	23.2	3.31
Systolic blood pressure (mm Hg)	118.00	2.79
Diastolic blood pressure (mm Hg)	79.00	3.01
Vo_2 max ml^{-1}. min^{-1}	55.34	2.39

Participants attended the lab at 8 a.m. in fasting condition. In the first stage, 5cc blood samples were taken from the participants' elbow vein. They performed Balke's 15-minute aerobic run to the point of exhaustion. Then, the second blood samples were taken from the participants and in the third stage, blood samples were taken after 24 hours of relaxation. Altogether, blood samples were taken at three different stages. The blood samples were sent to a pathology lab in each stage and were analyzed by a Biochemistry Analyzer Hitachi 717 machine. Serum magnesium concentration was measured according to nanogram per micro liter scale. SPSS version 16 was used for data analysis. The statistics methods utilized were one sample T test and Paired sample statistics.

3. Results

The mean and standard deviation of the athletes' serum magnesium concentration is shown in Table 2. As it can be seen in this table, the athletes' mean of serum magnesium concentration is

22.30 nanogram per micro liter in the first stage, and after performing Balke test, it has increased to 24.10 nanogram per micro liter, which means the increase is significant. (P=0.003), (t =4.07).

Table 2. Alteration of Serum Magnesium in Separate Three Phases.

Mg Stage (M±SD)			**Standard Deviation(Pair)**	**T - Values**	**P - Values**
1	2	3			
22.30±1.82878	24.10±1.10050		0.4422	4.07	0.003
22.30±1.82878		21.70±.94868	0.4761	1.26	0.239
	24.10±1.10050	21.70±.94868	0.3399	7.06	0.0001

The participants were given 24 hours to rest. The concentration of serum magnesium in the third stage was measured 21.7 nanogram per micro liter. The comparison of the means of serum magnesium concentration in the second and third stages indicated a significant alternation (P = 0.0001), (t = 7.06), (table 2). The comparison of the means of serum in the first stage (22.30 nanogram per micro liter) with that of the third stage (21.7 nanogram per micro liter) revealed a 0.6 nanogram per micro liter decrease which means there is no significant alternation between these two stages (P = 2.239), (t = 1.26), (figure 1).

4. Discussion

Most mineral elements play a vital role in human body. Very slight changes and alterations in these elements in nanogram scale lead to significant alternations in vital bodily functions. These alternations may appear in energy metabolism [1], glycogen breakdown, fat oxidation, protein and ATP synthesis and cardiovascular and neuromuscular functions [2, 3]. The aim of this research is to study alternations of serum magnesium concentration in male athletes after the exhausting physical exercise of Balke test and the comparison of its results with the ones obtained after 24 hours of rest.

The results obtained indicated that extreme physical activity and the performance of Balke test to the point of exhaustion result in a 7.76% nanogram per micro liter increase in serum magnesium concentration.

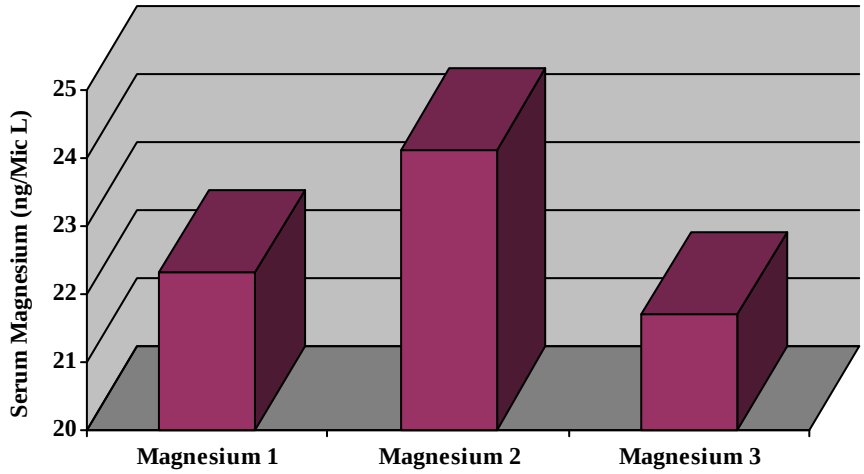

Fig. 1. The Changes of Serum Magnesium According Nano Gram Per Micro liter

The results of the present research agree with those of the research by Stending-Lindberg et al. (1996), which reported an increase in plasma magnesium level after physical exercise [17]. However, the results of the present study do not confirm those of the research carried out by Mooren et al. (2005), which reported a decrease in serum magnesium after physical exercise. Different results may be due to the fact that alteration in serum or plasma magnesium level depends on the kind of training and physical exercise [20]. This research also indicated that the participants' 24 hours of relaxation causes a 2.69% nanogram per micro liter increase in serum magnesium in the third stage in comparison with the first stage. In this regard, the results of the current study agree with those of Stending-Lindberg's research (1996). They claimed that serum magnesium concentration decreases after 24 hours of rest and reaches below the normal level. Also in the present study, the participants' 24 hours of rest caused the level of serum magnesium to reach below the mean of the first stage. It can be concluded that different physical activities can generate different responses in the concentration of plasma or serum magnesium. On the other hand, the duration and intensity of the physical activity and training are also among the major decisive factors in the amount of serum magnesium of blood. It seems that the increase in serum magnesium concentration after physical activities is related to magnesium release from its pool and increases its quantity and level in blood. Relaxation after physical activities causes magnesium to be excreted from the body through sweat [22].

As a result, magnesium level decreases after relaxation. The decrease or alternation in some minerals such as magnesium causes the athletes' skill and performance to decline [19]. It is advised that athletes consume foods that are rich in minerals, so that their performance is not impaired [23].

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References

[1] M.E. Shils, J.A. Olson, M. Shike. eds., Modern nutrition in health and disease. 8th ed. Philadelphia: Lea & Febiger. 164–84 (1993).
[2] H.C. Lukaski. Am. J. Clin. Nutr. 72: 585–593 (2000).
[3] R. Mogulkoc, V. Cinar, A. Kasim, Baltaci. pak. J. Med. Sci. Vol. **25** (2) 238-242 (2009).
[4] JY. Lin, SY. Chung, MC. Lin. Life Sci. **71**, 803–811 (2002).
[5] NE. Saris, E. Mervaala, H. Karppanen, JA. Khawaja, A. Lewenstam. Clin Chim Acta. **294**,1 (2000).
[6] A. Cordova, M. Alvarez-Mon. Magnes Bulletin. **18**, 66-70 (1996).
[7] EM. Haymes. Med Sci Sports Exerc. **19,** 197-200 (1987).
[8] JR. Brotherhood. Sports Med. **1,** 350-89 (1984).
[9] M. Clark, DB. Reed, SF. Crouse, RB. Armstrong. Int J Sport Nutr Exerc Metab. **13,** 303-19 (2003).
[10] F. Couzy, P. Lafargue, CY. Guezennec. Int J Sports Med. **11**, 236-63 (1990).
[11] JC. Chatard, C. Boutet, C. Tourny, S. Garcia, S. Berthouze, CY. Guézennec. Eur J Appl Physiol Occup Physiol. **77**, 157-63 (1998).
[12] FC. Mooren, SW. Golf, A. Lechtermann, K. Volker. Life Sci. **77**, 1211– 1225 (2005).
[13] S.M. Cheng, L.L. Yang, S.H. Chen, M.H. Hsu, I. J. Chen, F.C. Cheng. Eur J Appl Physiol. Springer-Verlag (2009).
[14] HC. Lukaski, WW. Bolonchuk, L. Kelvay, DB. Milne, HH. Am J Clin Nutr. **37**, 407 (1983).
15] SW. Golf, S. Bender, J. Gruttner. Cardiovasc Drugs Ther. **12,** 197–202 (1998).
[16] MJ. Laires, Y. Rayssiguier, CY. Guezennec, F. Alves, MJ. Halpern. Magnes Res **2**, 136 (1989).

[17] G. Stendig-Lindberg, Y. Shapiro, M. Tepperberg, D. Moran. Magnes Bull. **18**, 66 (1996).
[18] M. Fogelholm, S. Rehunen, CG. Gref, JT. Laakso, J. Lehto, I. Ruokonen, JJ. Himberg. Int J Sport Nutr. **2**, 351–365 (1992).
[19] V. Cinar, R. Mogulkoc, A. Kasim Baltaci. M. Nizamlioglu. Biol Trace Elem Res. **119**, 97 (2007).
[20] G. Haralambie, L. Senser. Eur J Appl Physiol Occup Physiol. **43**,115–125 (1980).
[21] Y. Rayssiguier, CY. Guezennec, J. Durlach. Magnes Res. **3**, 93–102 (1990).
[22] RJ. Maughan. Br Med Bull. **55**, 683 690 (1999).
[23] M. J. Pourvaghar.Gazz. Med. Ital. **167**, 105-108 (2008).