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NANO SCALE ALTERATION OF SERUM IRON AFTER PHYSICAL EXERCISE ON MALE

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The purpose of this research is follow-up examination for athletic men's serum Iron (Fe) alteration according to nano gram per micro liter (ng/mic L). So, twelve athletic men participated in this research. Subjects performed aerobic test of Bruce Protocol with a mean of 17.15 minutes. Researchers took blood sample from the subjects' elbow vein three times. The first stage was in a fasting state and before Bruce Protocol performing. The second stage was immediately after Protocol performing and the third blood test was taken after 24 hours of rest. Subjects' blood samples were analyzed in a pathology laboratory to determine their serum Iron concentration. Results indicated that, regarding blood serum Iron concentration, there is no significant difference in the first and second stages ($p = 0.52$). Also, there was no significant difference between the first and third stage ($p = 0.439$). While, the subjects' blood serum Iron concentration differed significantly between the second and third stage, i.e. after 24 hours of rest ($p = 0.44$). In this stage, the obtained reduction in the amount of blood serum Iron was 0.255 nano grams per micro liter. Results indicated that Iron serum alternation does not change immediately after physical activity. But, it seems that during resting and after exhausting physical activity, subjects' blood serum Iron decreases because of sweat and increase in metabolism.

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1. Introduction

Iron (Fe) deficiency is one of the most controversial issues in sports medicine and there are a many different opinions in the literature [1]. In athletes, Iron status can influence physiological functions and performance, particularly in endurance events [2, 3]. Iron is an essential mineral involved in the different physiological mechanisms related to physical performance and resistance (oxygen supply by hemoglobin, oxygen storage by myoglobin, oxygen utilization by cytochrome c, etc.) [2, 4].

Iron deficiency reduces the oxygen transport ability in the circulation because heme iron plays a role in supplying oxygen to tissue in humans [5]. Thus, Iron depletion, with or without anemia, may impair aerobic physical performance [4, 6]. Some authors have found a decrease in maximal oxygen consumption during strenuous exercise as a result of Iron deficiency [4, 6]. Iron is an essential structural component of biological compounds such as hemoglobin, myoglobin, cytochrome, cytochrome oxidase, cata-lase, and peroxidase [7]. Exercise is known to induce anemia in humans, which is called sports anemia (8, 9). Hemolysis was suggested to be one of the causes of sports anemia [10, 11, 12].

Because hemolysis promotes hemoglobin synthesis, exercise affects Iron metabolism. Moreover, a human study showed that exercise increased Iron loss through sweat [13]. Also, Iron homeostasis is altered in some athletes competing in and training for endurance sports [14]. It has been found that prolonged exercise increases the use and metabolism of Fe [15] and that 7 wk of intense physical exercise in untrained subjects significantly decreases Fe status [16]. In general, strenuous exercise and prolonged physical activity affect Iron metabolism and contribute to a condition characterized by reduced blood hemoglobin, serum Iron, and ferritin concentrations [17, 18].

The effects of exercise or physical activity on nutrient status are controversial. Iron status, for example, has been shown in some studies to be negatively affected by physical activity [19], whereas other studies have failed to show such effects [20, 21, 22]. A human study showed that short-term, high-intensity exercise stimulated the apparent absorption of Iron [23]. Strause et al. also reported that the apparent absorption of Iron was increased in rats by running to exhaustion in a "sprint" protocol [24].

Furthermore, Nachtigall et al. showed that the true absorption of Iron increased in long distance runners, but apparent absorption of Iron was decreased because of the gastrointestinal blood loss [25]. These reports suggested that the type of exercise affects the apparent absorption of Iron differently. The aim of this study was to evaluate levels of plasma Iron (Fe), according nano gram per mic L (ng/mic L) in athletes after aerobic physical activity.

2. Methodology

In this semi – experimental research, the effect of Bruce Protocol aerobic physical activity on athletic men's Iron (Fe) alteration was examined. The subjects of this research were twelve athletic men. Subjects had 5 years of sporting record in different physical activities. The mean and Standard Deviation (SD) of their age, weight, height, Body Mass, Index (BMI) and Maximal Oxygen Consumption ($Vo_{2\ max}$) were respectively: (19.6 ± 2.2), (69.3 ± 8.8), (171.5 ± 1.2), (22.23 kg^2), (63.4 $ml.\ kg^{-1}.\ min^{-1}$), (table 2).

The subjects attended a laboratory in fasting state at 8 o'clock in the morning. In the first stage, researchers took 5cc blood from each subject. Each subject settled in treadmill machine in turn and performed Bruce Protocol until exhausting time. Immediately after that, researchers took 5cc blood from each subject once more. Subjects were asked not to use any drug for 24 hours. After 24 hours of rest, they attended the laboratory once more and researchers took 5cc blood from each one. Blood samples were transferred to laboratory. They were analyzed by biochemistry analyzer Hitachi 717 machine and amounts of serum Iron concentration were measured according to nano gram per micro liter (table 3).

2-1. Bruce Protocol

The Bruce test is commonly used for treadmill exercise stress test. The exercise is performed on a treadmill. The test starts at 2.74 km/hr (1.7mph) and at a gradient (or incline) of 10%. At three-minute intervals the incline of the treadmill increases by 2%, and the speed increases as is shown in table 1.

3. Results

As it can be seen in table 3, subjects' serum Iron mean concentration in the first stage and before the Bruce Protocol physical activity was found to be 1.007 nano grams per micro liter. In the second stage the obtained concentration 1.152 and in third stage it was 0.897 nano gram per micro liter.

The result of this research showed that serum Iron concentration between the first and second stage was not significant ($p = 0.052$). Also, there was no significant difference between the first and second stages (p = 0439). But between the second and the third stages of this research, there was a significant difference in serum Iron concentration ($p = 0.044$), (Figure 1).

Table 1. Stages, Speed and Gradient of Bruce Protocol

Stage	Speed (km/hr)	Speed (mph)	Gradient
1	2.74	1.7	10
2	4.02	2.5	12
3	5.47	3.4	14
4	6.76	4.2	16
5	8.05	5.0	18
6	8.85	5.5	20
7	9.65	6.0	22
8	10.46	6.5	24
9	11.26	7.0	26
10	12.07	7.5	28

Table 2. Physical characteristics of the subjects.

Variables	Mean	Standard Deviation
Height (Cm)	176.02	4.78
Age (Yr)	21.54	2.28
Weight (Kg)	71.20	4.05
Vo2 max ml. kg^{-1}. min^{-1}	62.55	4.44
BMI (Cm^2)	23.55	2.58
Systolic blood pressure (mm Hg)	118.00	2.43
Diastolic blood pressure (mm Hg)	78.00	3.50

Table 3. The Changes of Serum Iron (Fe) (ng/mic l) with P and t Values in Three Stages.

Variables	Mean	Standard Deviation	p Values	T Values
Fe 1 (ng/mic l)	1.0070	0.3453	0.052	2.241
Fe 2 (ng/mic l)	1.1520	0.3508	0.439	0.811
Fe 3 (ng/mic l)	0.8970	0.2815	0.044	2.341

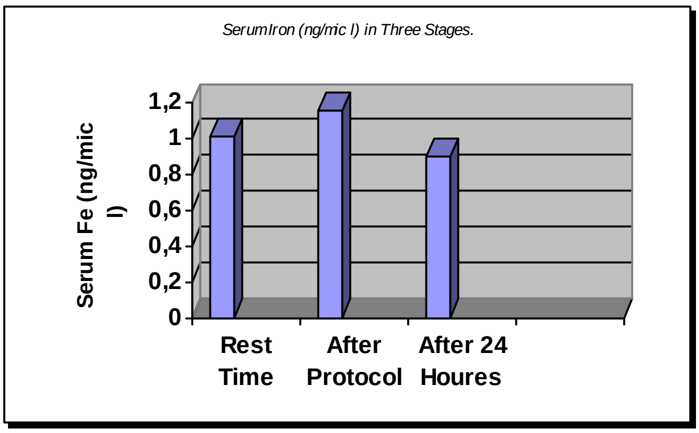

Fig. 1. Alteration of Serum Fe according nano gram per micro liter.

4. Discussion and conclusion

The purpose of this research is the examination of serum Iron alteration by using aerobic and exhausting physical activity. The performed activity was Bruce protocol. Even very minute reductions amounting to nano gram per micro liter could affect on athletes' integrity, method, and performance. Also it had an effect on oxygen supply by hemoglobin, oxygen supply by myoglobin and consumption of oxygen by cytochrome c [4, 2]. In the present research twelve athletic subjects participated. Researchers took blood sample three times from the subjects' elbow vein. The research results showed that between the resting state and immediately after Bruce aerobic protocol there was no significant difference. These findings show that athletes serum Iron did not decrease immediately after strong activity ($p = 0.052$). The present research findings were in agreement with Balaban et al. (1995) research (20), and Weight et al. (1992) [21]. On the other hand, this research did not consent with many researches such as Beard et al. (2000) [6], and Dang et al. (2001) [10]. Because these researchers did not measured significant decreased by strenuous physical activity [6, 10].

Findings of the present research show that the intensity and exhausting physical activity with intensity of Bruce protocol did not result in any alteration in athletics' serum Iron. We could say that maybe physical activity or the average time for performance of the Bruce protocol was not intense efficiently, so that results in basic alteration in athletics' blood Iron.

On the other hand, after 24 hours of rest, researchers took from samples, blood test for the third time. Serum Iron decreased amounting to 0.255 nano gram per micro liter. This decrease was accounted amounting to 22.13 % nano gram per micro liter. The decrease of the serum Iron causes anemia [10, 11, 12]. It also causes metabolism alteration [13, 15], and decrease of the hemoglobin and also decrease of the ferritin concentration [17, 18].

It seems, in this research, athletes' resting caused loss of Iron through sweat [13]. This research consents with Paulev et al. (1983) research [13]. Also we could attribute the decrease of the serum Iron to absorption increase in the body that accords with Straus et al. (1983) research [24]. Generally, we could say that intensity of the physical activity and its duration could have difference effects on Iron response during physical activity and after 24 hours of resting. On the other hand, athletes and also women [25] in comparison with untrained athletes need to use more Iron. Athletes should use foodstuffs that have more Iron in order not to encounter lack of Iron during physical activity and after that, because strenuous and exhausting physical activity increases Iron metabolism in the body.

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References

[1] J. C. Chatard, I. Mujica, C. Guy, J. R. Lacour, Sports Med**.** **27**, 229–240 (1999).
[2] B. Magnuson, L. Hallaberg, L. Rossander, B. Swolin, Acta Med. Scand. **216**, 149–155 (1984).
[3] C. M. Weaver, S. Raaram, J. Nutr. **122**, 782 – 787 (1992).
[4] E. M. Haymes, J. L. Puhl, T. E. Temples, Med. Sci. Sports Exerc. **18**, 162 – 167 (1986).
[5] B. W. Tobin, J. L. Beard, Iron, in Sports Nutrition Vitamins and Trace Elements, I. Wolinsky and J. A. Drinskell, eds., CRC, New York pp. 137–156 (1997).
[6] J. Beard, B. Tobin, Am. J. Clin. Nutr. **72**, 594S – 597S (2000).
[7] P. R. Henry, E. R. Miller, Iron bioavailability, in Bioavailability of Nutrients for Animals. C. B. Ammerman, D. H. Baker, and A. J. Lewis, eds., Academic, San Diego, CA, pp. 169–199 (1995).
[8] H. Yoshimura, Nutr. Rev. **28**, 251 – 253 (1970).
[9]. R. R. Pate, Phys. Sports Med. **11**, 115 – 131 (1983).
[10] C. V. Dang, J. Am. Vet. Med. Assoc. **286**, 714 – 716 (2001).

[11] S. S. Gropper, D. Blessing, K. Dunham, J. M. Barksdale. Biological Trace Element Research Vol. 109, 2006
[12] Y. Inoue, A. Matsui, Y. Asai, F. Aoki, T. Matsui, H. Yano, Vol. 107, (2005).
[13] P. E. Paulev, R. Jordal, N. S. Pedersen, Clin. Chem. Acta **127**, 19–27 (1983).
[14] P. M. Clarkson, Minerals, J Sports. Sci. **9**, 91 – 116 (1991).
[15] A. Pattini, F. Schena, G. C. Guidi, Eur. J. Appl. Physiol. **61**, 55 – 60 (1990).
[16] A. Magazanik, Y. Weinstein, R. A. Dlin, M. Derin, S. Schwartzman, Eur. J. Appl. Phisiol. **57**, 198 – 202 (1988).
[17] J. J. Lamanca, E. M. Haymes, Int. J. Sport Nutr. **2**, 376 – 385 (1992).
[18] D. Garza, I. Shrier, H. W. Kohl, P. Ford, M. Brown, G. O. Matheson, Clin. J. Sport Med. **7**, 46 – 53 (1997).
[19] D. Seiler, D. Nagel, H. Franz, P. Hellstern, C. Leitzmann, K. Jung, Int. J. Sports Med. **10**, 357 – 362 (1989).
[20] E. P. Balaban, P. Snell, J. Stray-Gundersen, E. P. Frenkel, Int. J. Sports Med. **16**, 278 – 282 (1995).
[21] L. M. Weight, M. Klein, T. D. Noakes, P. Jacobs, Int. J. Sports Med. **13**, 344 – 347 (1992).
[22] F. Rahmani-Nia, N. Rahnama, S. Masoumi. Int. J. Sports Sci. Engin. Vol. 01 No. **03**, 189 – 194 (2007).
[23] A. Kasugai, M. Ogasawara, A. Ito, Jpn. J. Physiol. Fitness Sports Med. **41**, 530 – 539 (1992).
[24] L. Strause, J. Hegenauer, P. Saltman, Nutr. Res. **3**, 79 – 89 (1983).
[25] D. Nachtigall, P. Nielsen, R. Fischer, R. Engelhardt, E. E. Gabbe, Int. J. Sports Med. **17**, 473 – 479 (1996).