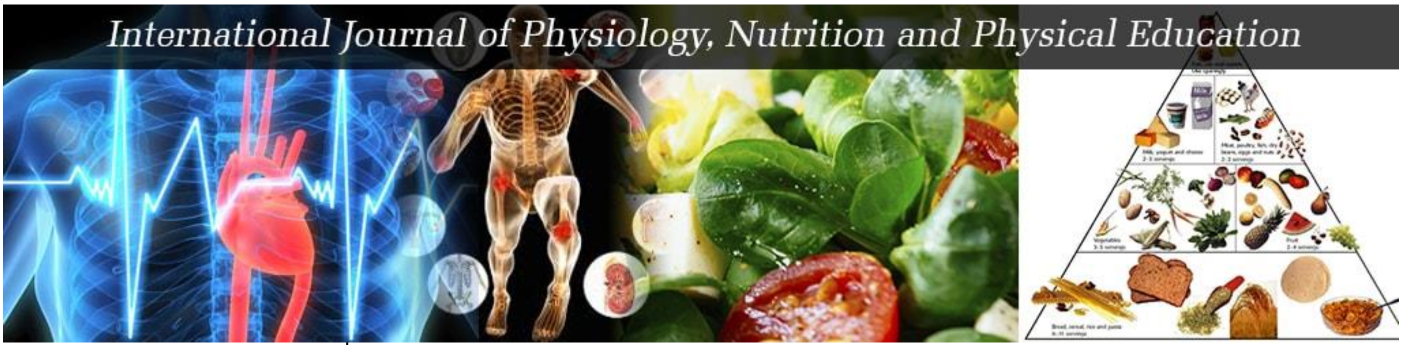

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Evaluation of changes in selective serum electrolytes before and after a maximum standard activity in male university endurance runners in Shiraz

Pooyan Sabet, Vahideh Razmi and Mahdi Soleimani Farrokh

Abstract
This study aimed to investigate the effect of the maximum standard test on changes in selective serum electrolytes before and after a 12-week training period. This study was a quasi-experimental study in which 40 male university endurance runners of Shiraz city who had volunteered participated. Laboratory instruments and measuring instruments such as flame photometers, spectrophotometer, and atomic absorption were used to determine blood electrolytes, and statistical analysis was performed by continuous t-test. The test results showed that the concentrations of sodium, potassium, calcium, magnesium, and Chlorine in post-tests before and after the training period, compared to pre-tests before and after the training period, were at (P<0.05%) found a significant difference. The overall result of the study is that electrolyte changes depend on the duration and intensity of exercise. Excessive changes in electrolyte concentrations can impair optimal athletic performance. Endurance athletes should be advised not to skip electrolyte supplements and drink fluids.

Keywords: selective electrolytes, blood serum, maximum standard test, endurance runners

Introduction

Electrolytes are one of the essential elements in the body. These metal elements make up about 4% of body weight. Except for calcium, which is involved in the structure of bones and teeth and is found in more significant amounts in the body, other minerals are present in much smaller amounts in the structure of tissues and blood (Pasalar, 2015) [1]. Usually, in healthy people, plasma anions and cations are equal. These minerals have vital functions in the body, such as: regulating the ratio of body water in the three spaces, affecting muscle contraction, helping to metabolize fats, transmitting electrical impulses to nerve fibers. The importance of electrolytes and their essential role in sports has led to more attention from researchers and sports scientists. Endurance sports have received more attention due to the sport's growing popularity, and many people are interested in these sports for reasons such as weight loss and maintaining fitness. In a study of changes in serum electrolyte levels, while running, 18 marathon runners were evaluated. The results showed a significant decrease in magnesium concentration and a significant increase in sodium and potassium levels (Cohen and Zimmerman, 2015) [4]. In another study, an increase in calcium concentration and sodium-potassium pump was examined after 100 km of running, and no significant change was observed in plasma sodium and muscle and muscle potassium. However, a significant increase in plasma potassium was observed by 37% (Garth *et al*., 2012). Two separate studies of rugby players in Japan showed similar changes in serum sodium and potassium concentrations. In both studies, sodium concentration decreased significantly, and serum potassium concentration increased significantly (Takarada 2013, Mashiko 2014) [14].
The following five sub-questions can be asked to navigate the main research question: 1- Does endurance running affect serum sodium concentration? 2- Does endurance running affect serum potassium concentration? 3- Does endurance running affect serum chlorine concentration? 4- Does endurance running affect serum calcium concentration? 5- Does endurance running affect serum magnesium concentration?

Research Methodology

The present study is a quasi-experimental and field study in which 40 male university endurance runners of Shiraz city who were randomly selected were present.

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Maximum oxygen consumption (ml / kg / min)		Weight (kg)		Height (Cm)	age (Year)	Index of groups
After Practice	Before Practice	After Practice	Before Practice			
40/83±7/75	33/71± 7/47	67/8±2/92	68/2±7/35	175/6±3/50	24/2±1/79	Endurance runners

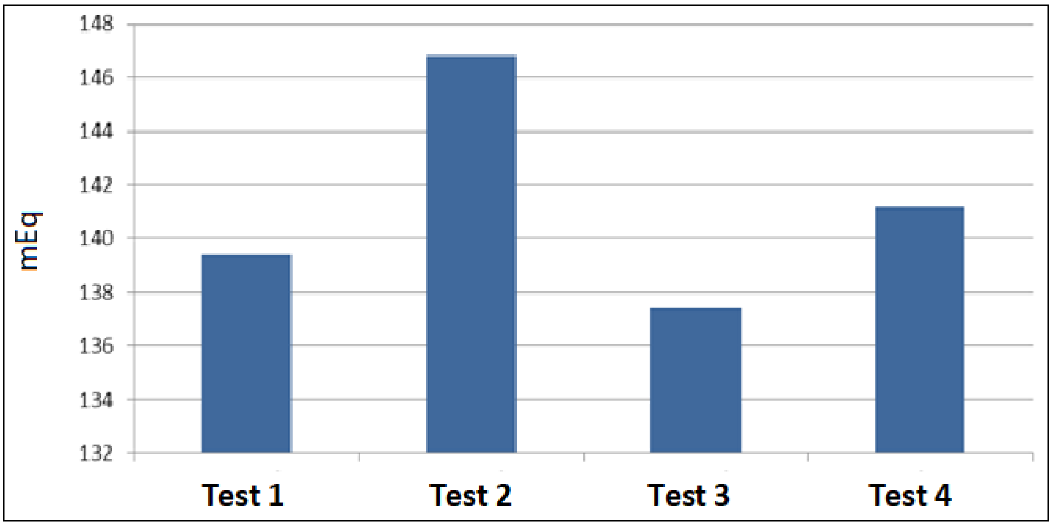
Information about the subjects was obtained by asking them questions and taking blood samples in the laboratory. Subjects were present at the laboratory on an empty stomach in the morning. Blood samples were taken from the brachial vein of the right hand of all subjects. After warming up, the subjects took turns running on the treadmill. After the test, blood samples were retaken. The speed of the treadmill was constant during the test and was equal to 1.7 mph. But every two minutes, 2.5 degrees was added to the slope of the device. The test on the treadmill started from a slope of 2.5 and increased to a slope of 12.5. All exercises were performed in the hot and dry climate of Shiraz at an average of 30.15±0.87. The blood sample was decomposed in a centrifuge at 3700 rpm. Blood serum was analyzed to obtain electrolyte concentrations in the laboratory. To determine the amount of sodium and potassium in the blood, the method of stimulating the outer surface of the ions with heat and a photometer was used. Chlorine content was measured by chlorometer and calcium by titration method and spectrophotometer. Magnesium content was measured using the optical source method and atomic absorption apparatus.

Statistical Analysis

Descriptive statistics (including mean, standard deviation) and inferential statistics (including Pearson correlation coefficient), and continuous t-test were used to analyze the data.

Sodium

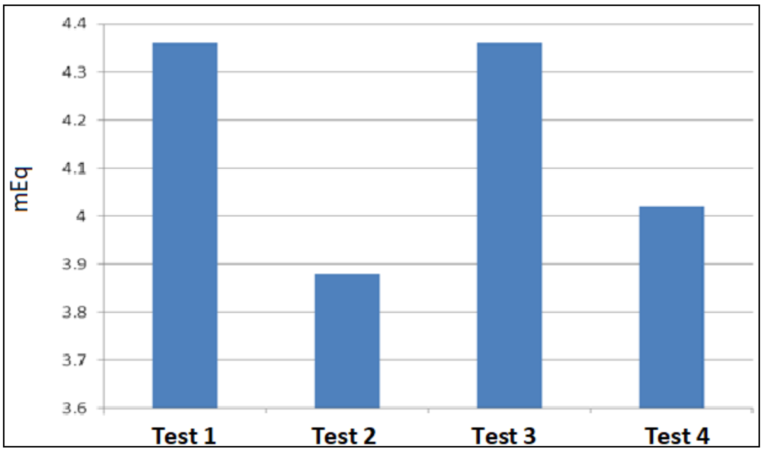
The sodium level in plasma in the Post-test, as compared to the Pre-Test before the training period, was increased by 5.3%, equal to 7.4 mEq. During this period, sodium increased from 139.4 ± 3.3 mEq to 146.8 3 3.8 mEq. Comparison of pre-test and post-test after the training period also shows an increase of 2.8%, equal to 3.8 mEq in the post-test. Comparison of sodium in the two pre-tests before and after the training period shows that it decreases by 2 mEq in the second pre-test, equal to 4%. Sodium decreased from 139.4 ± 3.3 mEq to 137.4 ± 1.4 mEq. Also, the post-test after the training period was reduced by 3.9%, equal to 5.8 mEq, compared to the post-test before the training period. Sodium decreased from 146.8 3 3.8 mEq to 141.2 4 4.4 mEq.



Graph 1: Sodium changes in endurance athletes

Potassium

Comparison of tests 1 and 2 (pre-test and post-test of maximum activity before the training period) shows that the potassium content of endurance runners has decreased from 4.36 ± 0.34 mEq to 3.88 E 0.35 mEq, which represents a decrease of 11%. This value is equal to 0.48 mEq. The amount of potassium in the third test (pre-test after the training period) is equal to 4.36 ± 0.2 mEq, which decreases by 7.8% to 4.02 32 0.32 mEq in the fourth test. The observed reduction is 0.34 mEq. No change was observed in the two pre-tests of maximum activity before and after the training period. However, the comparison of post-tests of maximum activity before and after the training period shows a 3.6% increase in the post-test after the training period. The amount of potassium has increased from 3.88 mEq to 4.02 mEq. The observed increase was 0.14 mEq.

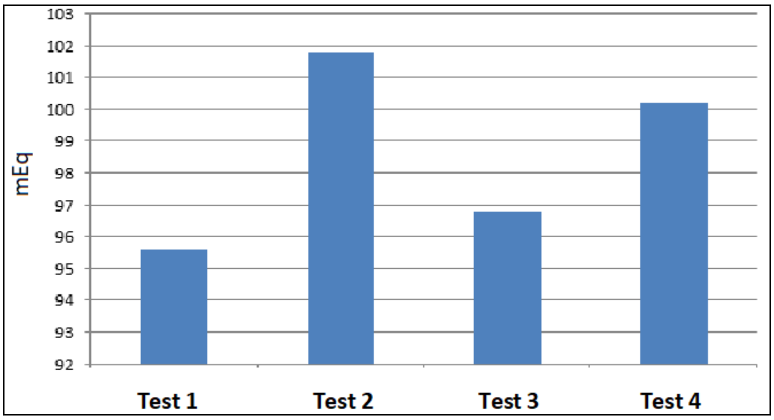


Graph 2: Potassium changes in endurance athletes

Chlorine

The amount of plasma chlorine in the pre-test before the training period (Test 1) was equal to 95.6 4.1± mEq, which increased by 6.4% to 101.8 ± 4 mEq in the post-test before the training. The observed increase was 6.2 mEq. Also, the amount of Chlorine in the pre-test after training (test 3) was equal to 96.8 ± 3.6 mEq, which in the fourth test (post-test after training) increased by 100.2 ± 4.4 mEq that representing an increase of 3.5 percent. This increase was 3.4 mEq. In comparison of the two pre-tests, it was observed that Chlorine increased by 1.3% in the pre-test done after the training, which was an increase of 1.2 mEq.

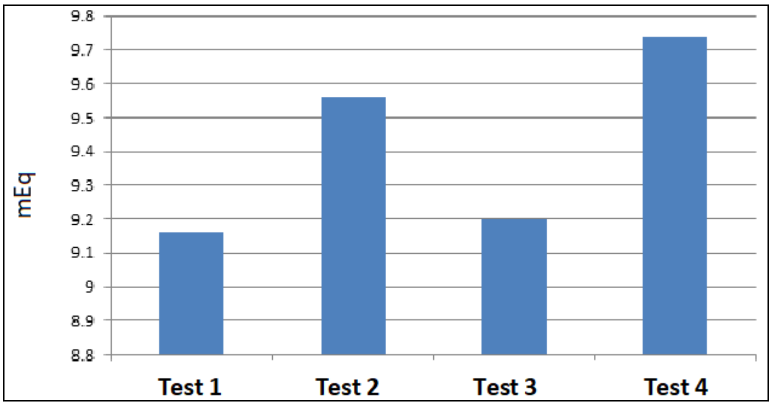
Conversely, the amount of Chlorine in the post-test after the training period decreased by 1.6% compared to the post-test before the training period. The observed reduction was equal to 1.6 mEq. Chlorine was reduced from 101.8 to 100.2 mEv.



Graph 3: Chlorine changes in endurance athletes

Calcium

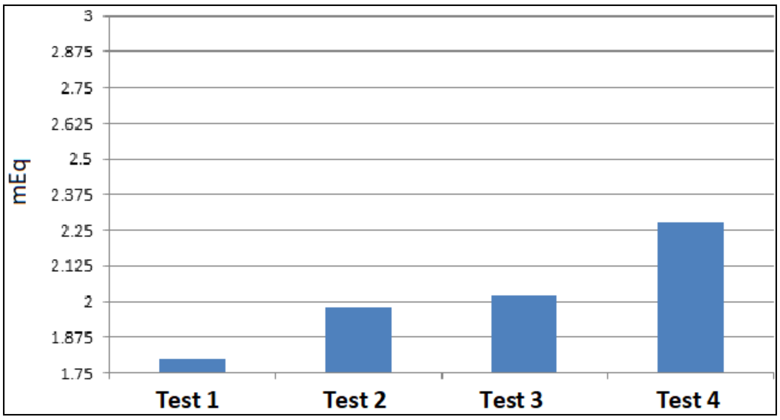
Calcium level increased from 21/0±16/9 mEq / L in the first test (pre-test before training) to 32/0±56/9 in the second test (post-test before the training). This shows an increase of 4.4% or 0.4 milliequivalents. Comparing the third and fourth tests, the amount of calcium was increased from 9.20 ± 0.23 mEq in the pre-test after training to 9.74 ± 0.42 mEq in the post-test after training. The observed increase was 0.54 mEq that is equal to 5.9% increase. Comparison of tests 1 and 3 (maximum activity pre-tests) shows an increase of 0.04 mEq / L in the third test (after training), which is equal to 0.4%. The amount of calcium increased from 9.16 mEq to 9.20 mEq. Also, the amount of calcium in the fourth test (post-test after the training period) increased to 0.18 mEq, equal to 0.33%. Calcium increased from 9.56 to 9.74 mEq.



Graph 4: Calcium changes in endurance athletes

Magnesium

The amount of magnesium in the post-test before the training as compared to the first pre-test increased from 1.80 ±0.6 mEq to 1.98± 0.04 mEq, which indicates a 10% increase. This increase was 0.18 mEq. Also, magnesium was increased in the post-test after the training period (Test 4) as compared to the pre-test (test 3) from 2.02 ± 0.5 mEq to 2.28 12 0.12 mEq. That is to say that it increased by 12.9% or 0.26 mEq. Comparison of pre-tests before and after training (1 and 3) also shows an increase of 0.22 mEq equal to 12.2% in the third test. The amount of magnesium increases from 1.80 mEq to 2.52 mEq. Comparison of post-tests before and after training (2 and 4) also shows an increase of 0.3 mEq, which is equal to 15.2% increase in the fourth test. The amount of magnesium increases from 1.98 04 0.04 mEq in the second test to 2.28 2 0.2 mEq in the fourth test.



Graph 5: Magnesium changes in endurance athletes

Conclusion

Sodium

Different results have been presented for sodium changes after physical activity. Several studies have shown a significant increase in sodium concentration, especially after prolonged and intense activity and marathon and endurance run (Nash 2009, Mashiko 2014) [11], consistent with this study's results. In some studies, a significant decrease in sodium concentration was observed (Cohen 2015, Bourne 2011) [4], which contradicts the present study's findings.

Sodium is important because of its essential role in homeostasis. Many minerals' concentration is directly or inversely related to sodium concentrations and is regulated by sodium (Pasalar, 2015) [1]. Many researchers attribute the decrease in sodium concentration to the loss of this element through sweat and urine. This study indicates an increase in sodium after the maximal test and after the training period, which may be related to the loss of sodium through sweat. Because the amount of water in sweat is always more than the amount of sodium; as a result, sodium is lost during a long period of exercise, and with a sharp decrease in plasma volume, there is a significant increase in serum sodium concentration. Also, sodium reabsorption from renal tubules may be the reason for the increase in serum sodium after the test (Pasalar, 2015) [1].

Potassium

Potassium is an element that is inversely related to sodium. By absorbing a sodium ion from the renal tubules, a potassium ion is excreted in the urine. Research shows that physical activity increases potassium concentrations (Mashiko 2014, Kodama 2013) [8]. Reabsorption of potassium from renal tubules due to an inverse relationship with sodium is the release of potassium from skeletal muscle due to acidification of the environment or muscle damage (Pasalar, 2015) [1]. Since in the present study, potassium decreased after the maximum tests before and after the training period, the results of this study contradict the findings of other researchers. Perhaps the reason is the excretion of more potassium in sweat and urine; another possible reason is the training program period and the response of this mineral due to the compatibility of this electrolyte with the duration and type of exercise.

Chlorine

The concentration of Chlorine in the body depends on and is regulated by the concentration of serum sodium. The research results show a decrease in chlorine concentration, which contradicts the results of this study. The findings of this study show that the chlorine concentration increases after the maximum tests. This may be due to the close relationship between sodium and Chlorine, a decrease in plasma volume due to excessive water loss in sweat compared to Chlorine. As a small amount of Chlorine is lost during exercise, the plasma chlorine concentration increases. The results show that the plasma chlorine concentration increases after the training period, compared to its concentration before the start of training. Since sodium and Chlorine are excreted in the form of salt through sweat, and the ratio of Chlorine to sodium in salt is 40 to 60, this may be one of the reasons for further changes in serum chlorine. Decreased chlorine concentration can be associated with high water intake during exercise and the thermal adaptation of athletes.

Calcium

Serum calcium concentrations increased after the maximal test, which confirms the results of others (Kodama 2013, Overgard 2009) [8]. The release of calcium from the sarcoplasmic reticulum due to muscle contraction and decrease in plasma volume due to excessive sweating and loss of more water compared to calcium in sweat is one of the reasons for increasing serum calcium concentration (Pasalar, 2015) [1]. Calcium depletion in some studies (Kovacs 2010) [9] may be due to increased water intake by subjects during exercise and increased plasma volume.

Magnesium

Some studies show that magnesium concentration decreases due to physical activity (Cohen 2015, Bachmann 2010) [4], which contradicts the findings of this study. Loss of magnesium in sweat and its absorption by free fatty acids due to the direct effect of magnesium on fat metabolism and fat energization in endurance training is one of the important reasons for magnesium reduction during and after training (Pasalar 2015; Warburton 2013) [1, 15]. The findings of this study show that the concentration of magnesium increases due to maximal activity, which is one of the possible reasons: a decrease in plasma volume due to sweating and excretion of small amounts of magnesium in sweat.

The results show that serum electrolytes undergo changes in their normal range due to endurance training or standard maximum test. These changes can damage the optimal performance of the sport. For example, severe changes in magnesium levels may lead to heart damage. Excessive use of pure water or not consuming fluids during exercise can lead to a sharp decrease or increase in electrolytes, which is detrimental to the health of athletes. Some believe that adding a small amount of salt to pure water can prevent severe changes in electrolytes and prolong the duration of exercise.

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