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THE FOLLOW-UP STUDY OF SERUM CALCIUM IN NANO GRAM PER MICRO LITER SCALE IN MALE ATHLETES

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Changes in rare elements of the body, even in the scale of nanogram per microliter result in disorder in the performance of vital bodily functions. The purpose of this research is to study the alterations in blood serum calcium after exhausting aerobic activity and 24 hours afterwards. To this end, twelve male student athletes were divided into two groups of six. The participants performed Balke 15-minute run in university's running track. Blood samples were drawn from the participants in a fasting state in three different stages. In the first stage, blood samples were drawn before Balke aerobic exercise; in the second stage, after the aerobic exercise, and in the third stage after 24 hours of rest. SPSS software (version 16) and the method of paired samples statistics were used. Comparison between the means of the first stage, 98.38 nanogram per microliter (ng/mic L), and that of the second stage, 114.96 ng/mic L, showed a significant difference (P= 0.0001). Similarly, comparison of the means of serum calcium in the second with the third stage, 104.46 ng/mic L, showed a significant difference (P= 0.0001). Research results showed that exhausting aerobic activity increases serum calcium of the participants' blood. The increase in serum calcium is an indication that calcium is sent from other bodily organs towards blood. Also, it indicates the athlete's bodily need to calcium consumption before performing the exhausting aerobic exercise.

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1. Introduction

All trace elements participate in many physiological and biochemical events in human body. They are especially active in lipid and protein metabolism. Therefore, it is important to observe whether exercise affects the functions of these elements or not [1, 2]. Moderate endurance exercise and physical activity have a positive effect on calcium metabolism and bone by increasing bone mineral density and reducing urinary calcium loss, whereas immobilization has the opposite effects [3]. Intestinal calcium absorption affects bone mass and bone strength both of which directly contribute to exercise performance. Previous investigations in humans and rats suggested that endurance exercise stimulated intestinal calcium absorption in vivo; however, the underlying mechanisms remain controversial [3].

On the other hand, immobilization decreased the intestinal calcium absorption partly by reducing the serum level of 1, 25- dihydroxyvitamin D3, one of the major calcium-regulating hormones, and the expression of several calcium transporters genes. Ninety-nine percent of calcium is stored in bone as hydroxyapatite crystal, while 1% is present as ionized calcium in the intracellular (ICF) and extracellular fluid (ECF). Efective calcium homeostasis is essential for most of the biological processes, including bone metabolism, cell proliferation, blood coagulation, hormonal signalling transduction, and neuromuscular functions [3].

Calcium balance is maintained by concerted functions of three major organs, i.e., the gastrointestinal tract, bone, and kidneys. Adult humans daily ingest about 500-1200 mg calcium, ~30% of which is absorbed in the small intestine by a mechanism that is controlled primarily by the calcitropic hormones, i.e., 1,25-dihydroxyvitamin D3 (1,25-(OH)2D3) and parathyroid hormone (PTH) [4, 5].

Changes in calcium metabolism during exercise are dependent on the exercise intensity. Moderate endurance exercise increases serum 1, 25(OH) 2D3 level [6, 7], but decreases serum PTH [7]. Despite decreased level of PTH, urinary calcium excretion is decreased [7]. Plasma ionized calcium may be normal or slightly increased [7, 8]. In bone, endurance exercise increases bone mineral density (BMD), bone strength [9] and bone formation rate [10]. Thus, moderate endurance exercise seems to induce positive calcium balance, and has a beneficial effect on bone metabolism [4].

It is stated in several studies that physical activity has mechanical loads to the skeleton via gravitational forces and muscular pull at sites of attachment [11]. Osteogenic response is suggested to be site-specific to the anatomic sites at which the mechanical strains occur [12, 13, 14]. Optimal stimulus for skeletal development is especially achieved by Weight-bearing exercises [11]. Weight-bearing stimulus can be produced by both resistance exercises and aerobic exercises [15]. It is reported that appropriate overload for improving bone mass must induce forces greater than those experienced by activities of daily living [11].

On the other hand, strenuous exercise leads to detrimental effects on calcium metabolism. It increases serum PTH concentration, thereby resulting in decreased BMD and low bone mass [16, 17]. The purpose of this research is to investigate the effect of strenuous and exhausting exercise on blood serum calcium concentration response in athletes.

2. Methodology

In this semi-experimental research, the effect of exhausting aerobic exercise on serum calcium alterations in male athletes was studied. The subjects of this research were 12 male athletes. Means and Standard Deviations of the height, weight, age, and body mass index (BMI) of the participants were (175.90±6.26), (74.54±7.027), (22.36±1.74), and (23.21±2.22) respectively (Table 1). The participants attended the laboratory at 8 a.m. in a fasting state. In the first stage, 5cc blood samples were drawn from the participants. The participants were asked not to take any drugs during the 24-hour relaxation period. After 24 hours of rest, the participants attended the laboratory again and in the third stage 5cc blood samples were drawn from their elbow vein. Blood samples were sent to a pathology laboratory and were analyzed by Biochemistry Analyzer Hitachi 717.

Serum calcium concentration was measured according to nanogram per micro liter (ng/mic L) scale. SPSS version 16 was used. Also, means of the three stages of serum calcium were statistically analyzed according to ng/mic L using one-sample test and paired samples statistics.

Table 1. The Characteristics of Subjects.

Variables	Mean	Standard Deviation
Age(Yr)	22.36	1.74
Height(Cm)	175.90	6.26
Weight(Kg)	74.54	7.027
VO_{2max} $ml^{-1}. min^{-1}$	56.66	4.23
Systolic blood pressure (mm Hg)	117.00	2.40
Diastolic blood pressure (mm Hg)	79.00	4.83
BMI Cm^2	23.21	2.22

3. Procedure

Balke 15 minutes run

This 15-minute run test, designed by Bruno Balke, is one of many field tests designed to measure aerobic fitness. This test has formula to predict VO_{2max} from the run distance. Participants run for 15 minutes, and the distance covered is recorded. Walking is allowed, though the participants must be encouraged to push themselves as hard as they can (18). The original formula by Balke is: $VO_{2max} = 6.5 + 12.5 \times$ kilometers covered.

4. Results

Mean and Standard Deviation of the three stages of participants' blood tests are recorded in table 2. Also in Table 3, Standard Deviation of each pair of blood samples along with their T and P values are recorded. Means are measured in ng/mic L.

As it can be observed in Table 3, the participants' mean of serum calcium concentration in the first stage and before Balke exhausting aerobic exercise was measured 98.38 ng/mic L. In the second stage, i.e. after the exhausting aerobic activity, it increased to 114.96 ng/mic L.

Research results indicated that the difference in serum calcium concentration between the first and second stages is significant (P= 0.0001).

Comparison of subjects' serum calcium in relaxation state and the third stage (104.46 ng/mic L) showed that the subjects' serum calcium is reduced. This decrease is significant (P= 0.0001).

Comparison of the means of the second stage (114.96 ng/mic L) with that of the third stage (104.46 ng/mic L), i.e. after 24 hours of rest, showed a significant difference (P= 0.0001) (Figure 1).

Table 3. Significant Level of results for Calcium According ng/mic L.

Variables (M±SD)	Variables (M±SD)	Standard Deviation	T – Values	P – Values
Calcium Stage1 (98.380±4.4307)	Calcium Stage2 (114.960±3.1476)	4.887	10.727	0.0001
Calcium Stage1 (98.380±4.4307)	Calcium Stage3 (104.460±4.3719)	3.430	5.604	0.0001
Calcium Stage2 (114.960±3.1476)	Calcium Stage3 (104.460±4.3719)	5.726	5.5727	0.0001

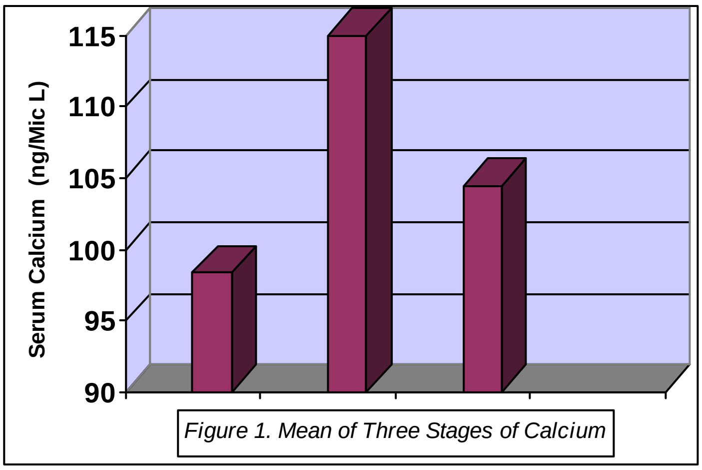

Fig. 1. Mean of three stages of Calcium

5. Discussion

The purpose of this research is to investigate the effect of strenuous and exhausting exercise on blood serum calcium concentration response in athletes. The current research showed that exhausting and intense exercise results in an extensive and significant alteration in the amount of serum calcium. Intense activity causes an increase in serum calcium immediately after aerobic exercise.

The amount of subjects' serum calcium in the first stage was measured 98.38 ng/mic L. This amount increased to 114.96 ng/mic L after Balke exhausting aerobic exercise test, which means it has increased 16.58 ng/mic L or 16.85%.

On the other hand, after 24 hours of rest the amount of serum calcium decreased 10.5 ng/mic L, compared with the second stage. This decrease is 9.13% ng/mic L. The current research is in accord with that of Pourvaghar (2008), which found significant changes in serum calcium, phosphorus, and magnesium after aerobic exercise [19]. Also, the present research agrees with that of Yeh [6, 7].

The reason behind contradicting results can be ascribed to diverse intensity of training and exercise, because different training intensities can influence hormone responses and make the results appear contradictory. On the other hand, physical exercise duration may exhaust muscular and serum calcium reserves. In addition, the fact that calcium resources and reserves of the participants' bodies can not be determined properly may affect the results of the study.

This study does not confirm the results of the research carried out by Dressendorfer (2002), who claimed that after intense activity urine calcium increases and serum calcium decreases [20].

The current research result showed that the participants' exhausting and intense exercise caused the serum calcium to increase. It seems that exhausting exercise sends calcium from its reserves towards blood so as to fulfill athlete's needs in strenuous and tiresome sports.

Balancing and regulating calcium concentration in blood is the responsibility of parathyroid hormone (PTM). It seems that intense stress resulting from the exercise and physical activity stimulates PTM gland and increases the amount of calcium in blood serum. On the other hand, subjects' 24 hours of relaxation reduces the stress and consequently, serum calcium concentration decreases.

Intense physical activity stimulates calcium metabolism and increases serum PTH concentration and, as a result, causes body mass density (BMD) to decrease [16, 17]. Therefore, since a decrease or disorder in calcium reserves of the muscles and the entire body leads to performance disorder in athletes, it is highly recommended that athletes include rich calcium resources in their regimen in order not to suffer from calcium shortage when taking part in tiresome and intense activities.

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