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The effect of zinc supplementation on Max Vo_2 and lactate levels in sedentary people

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ABSTRACT

Results of previous studies have shown that exercise influences zinc metabolism. The importance of zinc intake by diet in athletes has been emphasized and it has been argued that zinc deficiency in the diet can have unfavorable effects on performance. The present study aims to investigate how zinc supplementation affects Max VO_2 and lactate levels in sedentary people. The study included 10 male students who were not actively involved in sports. All subjects were supplemented with oral zinc sulfate (3mg/kg/day) for 4 weeks. Max VO_2 and lactate levels of all subjects were determined before and after zinc supplementation. Max VO_2 values of the subjects as measured after 4 weeks of zinc supplementation were numerically higher than the values measured before the supplementation, but the two values were not statistically different. Lactate levels, on the other hand, were found significantly lower after the supplementation, when compared to the levels before supplementation ($p<0,05$). Results of our study demonstrate that 4-week zinc supplementation leads to a significant decrease in lactate levels and delays exhaustion. Zinc supplementation can improve muscle strength and metabolism in physical activity. Consequently, physiological doses of zinc supplementation can be useful for performance.

Keywords: *Sedentary, zinc supplementation, Max VO_2, lactate.*

1. INTRODUCTION

Many researchers have stressed the relation between diet, and development and continuation of performance. Two methods are commonly used to determine the interaction between physical activity and diet. The first method is to give different nutrients to people involved in physical activity and examine their physiological and performance responses and the second is to explore the effects of physical activity on diet [1,2]. Therefore it can be said that there has been a growing interest in research about the relation between exercise, and minerals and elements [3]. There is fairly scarce information about the effects of zinc, which is known to be an important trace element in energy metabolism, on performance. Studies concerned with the relation between zinc and exercise usually focus on the distribution of this element in the body in response to exercise [4,5].

It has been demonstrated that long-time endurance training significantly reduces serum zinc levels in both male and female athletes when compared to sedentary people [6]. Decreased zinc levels in athletes involved in endurance sports can be explained by various mechanisms, but the major cause of this decrease can be zinc deficient diet [7]. It is known that zinc loss through perspiration and skin is higher in athletes than in the non-athletic population [8]. It has been noted that mild exercise increased zinc loss by perspiration in athletes and that this loss could be more in males than in females, in consideration of the amount of perspiration [9]. This phenomenon may be associated with the increase in urinary zinc loss as a result of skeletal muscle protein breakdown observed in regularly training athletes. Cordova and Alvarez [10] reported that muscle zinc concentration decreased due to low serum concentrations in athletes. Another report of Cordova was shown that low muscle zinc levels decreased durability [11]. In conclusion, the relation of the zinc with exercise and performance is inevitable because of a structural component of enzymes that carbonic anhydrase, alkaline phosphatase, alcohol dehydrogenase, carboxypeptidase, RNA polymerase and DNA polymerase that have a role on the metabolisms of carbohydrate, lipid, protein and nucleic acid [12, 13]. Aim of this study is to investigate how is zinc application affect the levels of Max VO_2 and lactate.

2. EXPERIMENTAL SECTION

2.1. Physical characteristics of the subjects and Zinc supplementation.

This investigation was done on the 10 male participant that average age 19.47±1.7 and height 178.7±5.3 cm whom have no active exercise. The participants were selected randomly from volunteer male students new starting School of Physical Education and Sports. It was applicated oral zinc sulfate (3 mg/kg/day) to all of participants for 4 weeks.

2.1.1. The measurement of weight and height. The measurements of weight and height were done by steelyard that have 0.1 kg sensitivity and standard meter that have 0.01 cm sensitivity respectively. The weight of participiants wase measured twice as the beginning and end of the study.

2.1.2. The measurement of percent of body lipid. The measurements of percent of body lipid were done by Fat Monitor/Scala TBF-531 max 136 d=0.2 kg(Tanita). The determination of percent of body lipid of participants weas done twice as the beginning and the end of the study.

2.2. Plasma Zinc analyses.

Plasma zinc was analyzed in Shimatsu ASC-600 Atomic Absorption Spectrophotometer in the Biochemistry Department of Elazığ Fırat University, Medical School. The measurements were repeated twice for each sample using flame atomization technique with light at 213.9 wavelength. Zinc levels were expressed as µg/dl.

2.3. Measurement of maximal aerobic strength.

Maximal aerobic strength was measured before and after zinc supplementation. Forty watts warm-up load was applied for 3 minutes in an electronic ergometer and onset load was determined so that heart rate will be 120-130 after one-minute exercise. The load was increased 9-14 watts a minute according to the performance at the onset load until exhaustion. Meanwhile, ventilatory and respiratory gas exchange parameters were measured in 20-second periods, using SensorMedics 2900 Metabolic Measurement Cart. The test was continued until the individual was exhausted.

2.4. Lactate measurements.

Plasma lactate level (mg/dl) was determined in Olympus AU 400 equipment using Randox lactate kit in 2,5 cc blood samples put into heparinized injectors immediately after maximal aerobic strength measurements.

2.5. Statistical evaluations.

Wilcoxon-Z test of non-parametric statistics was applied using SPSS statistics package software.

3. RESULTS SECTION

There were no signs in the percents of body lipid and average weights of participants after zinc application for 4 weeks (Table 1).

Table 1. The changes the percent of body lipid and weight of the participants.

	The percent of body (%)	Body weight (kg)
Before zinc application	15.40±5.25	70.82±9.20
After zinc application	15.70±4.88	71.06±8.87

Plasma zinc levels were significant compared to the beginning levels (p<0.05, Table 2).

Table 2. Plasma zinc levels Levels of the Subjects.

	Zinc (µg/dl)
Before zinc supplementation	105..00±35.47
After zinc supplementation	153.50±17.19^{A}

*Differences between mean values with different superscripted letters in the same column are statistically significant (p<0,05).

Max VO_2 values of the subjects as measured after 4 weeks of zinc supplementation were numerically higher than the values measured before the supplementation, but the two values were not statistically different. Lactate levels, on the other hand, were found significantly lower after the supplementation, when compared to the levels before zinc supplementation (p<0,05) (Table 3).

Table 3. Max VO_2 and Plasma Lactate Levels of the Subjects.

	MaxVO$_2$ (ml/min)	Lactate(mg/dl)
Before zinc supplementation	3213.20±250.62	118.86±25.88^{A}
After zinc supplementation	3303.30±254.52	102.55±27.91^{B}

4. CONCLUSIONS

Max VO_2 values of the sedentary subjects in the study after 4-week zinc supplementation were numerically higher than those before zinc supplementation, but the difference was not statistically significant. However, lactate levels after zinc supplementation were found lower than those before zinc supplementation. In a study including athletes, Khaled et. al. [14] subjected 12 professional football players to maximum exercise in a cycloergometer. Serum zinc levels of the subjects were found generally low and those who had low zinc levels were also observed to have high lactate levels. It has been reported that daily and regular exercising leads to impairments in zinc metabolism and that, the impairments in zinc metabolism, together with zinc loss, can bring about muscle exhaustion and weakness [3]. It was argued that zinc supplementation improved muscle strength and metabolism in physical activity, but zinc supplementation over recommended doses could have a negative impact on body health [15-17]. However, Singh et. al. [18] demonstrated that acute zinc and vitamin E supplementation did not have any effect on metabolic responses in women who were subjected to running exercise. The fact that the subjects were given a one-time acute zinc supplementation may be a disadvantage of the study concerned. The finding of low lactate levels despite the lack of a statistically significant difference in Max VO_2 levels in our subjects after 4 weeks of zinc supplementation is consistent with literature information. This finding suggests that zinc supplementation increases muscle strength and delays muscle exhaustion. Likewise, in a study by Brun et. al. [19] serum zinc levels in 20 gymnasts aged 12-15 were found lower than the controls and serum zinc levels of female gymnasts were established to be lower than those of male gymnasts. The same study showed a positive correlation between low zinc levels and isometric activity strength. It was concluded that low zinc levels could lead to impairments in pubertal growth and muscle performance. Results of the concerned study support our study results from a different perspective. It was demonstrated in a study by Baltaci et. al. [20] that zinc deficiency led to a significant increase in plasma lactate levels and zinc supplementation brought about a significant decrease thereof in rats subjected to acute swimming exercise. Low lactate levels obtained by Baltaci et. al. [20] as a result of zinc supplementation are consistent with the lactate values we found in the present study. Richardson and Drake have reported that the gastrocnemius muscle that obtained from rats which nourished with zinc plus diet has tired later than controls [21]. Again, another study has reported that DNA concentration of the muscle and its growing have reduced in rats which nourished with decreased zinc [22]. Results both of the studies are important because the zinc has a delaying effect on the tiredness [21, 22]. In addition, our results that obtained from our study as lower lactate levels are supported by these studies.

Our findings have shown that the zinc application delayed the tiredness via decreasing low lactate levels. The zinc application increases the strength of the muscle and metabolism. In conclusion, the zinc application may be useful in physiological doses on the physical activity.

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