*International Journal of Humanities and Social Science Invention*
*ISSN (Online): 2319 – 7722, ISSN (Print): 2319 – 7714*
*www.ijhssi.org ||Volume 6 Issue 1||January. 2017 || PP.01-04*

# Effect of Different Exercise Types Upon Blood Zinc and Copper Levels

Atilla Pulur[1]
[1](*School of Physical Education and Sports / Gazi University, Turkey*)

***ABSTRACT:*** *This study focused on investigating the effects of different types of exercise models (power endurance, maximal strength, and interval running) on the copper and zinc levels in blood. All male twenty four basketball players voluntarily accepted to be the subjects of this study. Subjects were put in three different groups according to their maximal strength (MS) (n=8), intermittent running power endurance (PE) (n=8) and interval run (n=8). Serum copper (Cu) and zinc (Zn) levels were calculated in accordance with atomic emission technique in blood samples gathered from the groups before and after training program. The difference in blood zinc levels pre and post exercise were found to be statistically significant (p<0.05) for all of the groups. The copper levels of all the groups which were calculated before and after the exercise didn't reveal a statistically significant change (p< 0.05). In the end power endurance group was better among the others at saving the zinc status of the body.*

***Keywords:*** *power endurance, maximal strength, interval running*

## I. INTRODUCTION

Physical exercise and causes numerous muscular, metabolic, and cardiovascular changes in human body. Trace elements of copper and zinc take part in many of these processes as they are enzymatic cofactors, but they especially take part at those related to oxygen transport, nutrients, metabolism, and creation of usable energy [1]. The athletes need to increase the vital minerals necessary for bodily performances and exercises but the researches done on athletes and non-training sedentary control groups revealed that growing dose of mineral might be lost in sweat during physical exercises[10].

Zinc is a micro nutrient which is vital for more than 300 enzymes and takes important role in many metabolic processes such as nucleic acid and protein synthesis, cell propagation, glucose utilization, reproduction of immunity tasting, wound healing, skeletal development and intestinal functions [9]. Zinc status has also a very important effect on physical performance. There is no agreement about the quantity of zinc left in blood following physical training. According to certain scholars the zinc quantity in blood decreases as a result of training [4,21] while others claim the opposite [11] .Copper is also one of the essential micronutrients for the human body. Copper deficiency results in Menke disease and some hereditary disorders. Copper is necessary for nearly 30 enzymes in the body. Its deficiency manifests itself as a decrease in plasma concentration [10]. For athletes sufficient amount of given minerals are essential for exercise and performance. During the physical exercise the sportsmen have been reported to have lower magnesium and zinc levels in their blood because of growing consumption and insufficient intake of these minerals in their diets [3,7] .If compared with the inactive state of the body, doing physical exercise increases the oxygen need up to10-15 times. As a result mitochondrial oxygen consumption paves the way to oxidative stress; this situation creates lipid peroxidation and reactive oxygen species. Growing free radical formation leads to muscle damage, swelling even muscle destruction, and affects the training negatively [13] . In blood serum concentrations of acute exercise in different types of training has effect on Na, K and CI levels. The reason of the increase and decreases in blood serum mineral levels post-acute exercise may be show as differences about duration, type, severity and extend of training [15].

The aim of this study is to find out the effects of zinc and copper amount in the plasma of the athletes according to Interval Run (IR), Power Endurance (PE) and Maximal Strength (MS) exercise types so that the mineral requirement of professional athletes following various training exercises.

## II. METHODOLOGY

### Training models

This study is based on effects of different training models. 24 all male and professional basketball players took part in it. The average age of the participants is 22 and they are 191,92 centimetres tall and 87,38 kilograms. Entrees are divided into 3 groups according to their Interval Run (IR), Power Endurance (PE) and Maximal Strength (MS). All groups are made of 8 people. Their average age, height, weight and BMI (body mass index) are as follows: IR group athletes are 19 years, 191,13 centimetres, 81,38 kilograms, 22,13kg/m2; PE group athletes are 23 years, 191,13 centimetres, 91,25 kilograms, 23,73kg/m2; MS group athletes are 24 years, 193,5 centimetres, 89,5 kilograms, 24,91kg/m2. As it is seen there are very little difference between all the groups according to their average age, height, weight and BMI values (p>0, 05).

For the IR training basketball court's 86 meter long line is used and the entrée's pulse is between 160-180 beats/sec. At standstill the pulse is held around 120beats/sec; at set breaks their pulse is held between 120-140 beats/sec and during jogging. Polar vantage NV Telemeters are used to record the heart beat rate throughout the IR (Polar Electro, Oy, Kempele, Finland).

PE training of each entree is made of 20-35% of MS data. Their schedule is planned as 3 sets. Values of these sets are 25% of MS in 24 times, %30 of MS in 22 times, and %35 of MS in 20 times. When training programs are planned, the difference between percentage and repeats are arranged in such ways that the training programs based on the literature would be very similar. Eight different moves are designed for training. While bench press, biceps, triceps and shoulder press exercises are used for the upper body; leg extension, squat, and step up with weight exercises are used for lower body.

Each entrée's MS is detected a week before using the training instruments and based on the data of the designed training program, MS training is divided to 3 sets, 80-95% based on MS and made of 3 sets. When exercise and resting periods are equal the MS values are 80% for 8 times, %85 for 7 times, and %90 for 6 times.

**Biochemical methods**

Blood samples acquired by bloodletting and examined for their zinc and copper concentration levels in the three categories. After being separated through centrifugation at: 3000xg, for 10 minutes and being cooled and held under refrigeration at-80 °C the serum was analysed. Plasma zinc and copper levels were calculated by flame atomic absorption spectrometry (FASS) (Shimadzu 680 AA Tokyo Japan).

**Statistical Evaluations**

The statistical evaluation of data was performed using a statistical package with Wilcoxon Signed Ranks Test (SPSS 18.0, USA). Arithmetic means and standard errors of all parameters were calculated. The blood zinc and copper levels were correlated with each different training type at a significance level of $p<0.05$.

## III. RESULTS

**Table 1:** Comparison of the pre and post training values of Zinc (Zn) and Copper (Cu) levels in Interval Running, Maximal Strength and Power Endurance exercise types.

| Variables | INTERVAL RUNNIG | | MAXIMAL STRENGTH | | POWER ENDURANCE | |
|---|---|---|---|---|---|---|
| | Pre-exercises | Post-exercises | Pre-exercises | Post-exercises | Pre-exercises | Post-exercises |
| Zinc (Zn) | 101.00 | 96.428 | 95.125 | 88.00 | 91.250 | 87.500 |
| Copper(Cu) | 12.877 | 12.867 | 15.808 | 15.951 | 19.015 | 16.458 |

Zinc levels of the serum samples which are collected following different kinds of exercises decreases significantly ($p<0.05$) while no significant change ($p>0.05$) is observed in the copper levels of the serum samples that are collected immediately after the exercise when compared to the resting levels (Table1). Figure l and 2 show the concentration of major elements in the serum.

**Figure 1:**Effect of exercise on Zinc levels (µg/dl) in different exercise groups.

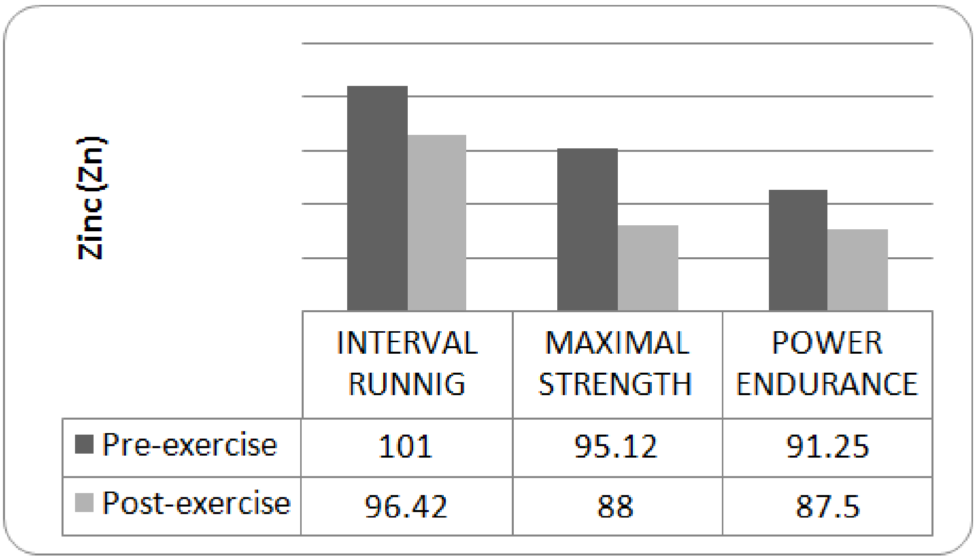
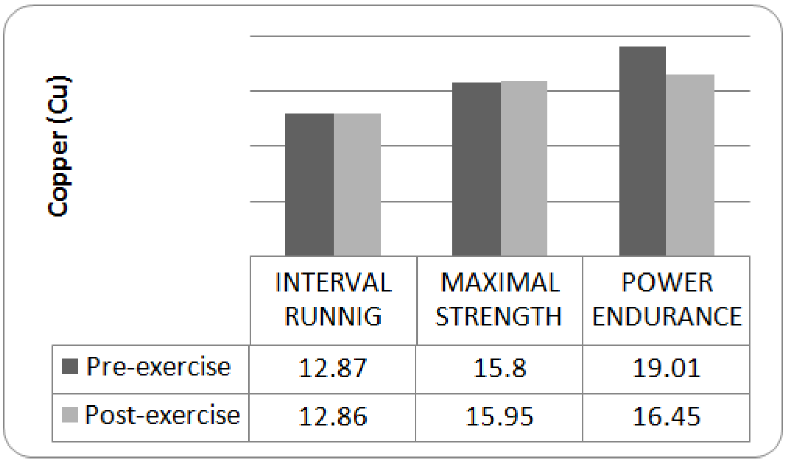


**Figure 2:**Effect of exercise on Copper levels (μmol/L) in different exercise groups.




## IV. DISCOSSION

Zinc has a very important role in keeping the structural integrity of DNA and synthesis of nucleic acid, protein and muscle functions [16]. Some zinc- containing enzymes like carbonic anhydrase and lactate dehydrogenase also play an intermediary role in metabolism throughout the exercise. Superoxide dismutase, which is a different zinc-containing enzyme, protects the cells against free radical damage[8]. To increase the efficiency of nutrition and exercise on health and bodily functions, people may make use of multivitamin and mineral supplements. Scholars who are in favour of supplementation refer to burgeoning evidence which vindicates that magnesium, zinc, and chromium have very significant roles in transforming chemical energy reserves in food to workforce and combining body functions to change physical performance [10].

It is clearly determined that zinc deficiency has serious effects on skeletal muscle [12] . It is proved that rats lived on very low zinc diet has significant skeletal and muscle development defects and less DNA concentrations. When formerly malnourished mice and children are fed with zinc and energy supplements, they have less muscle development deficiencies. According to experiments done on animals zinc is vital for skeletal muscle performance and endurance to fatigue [17] . Generally a decrease is seen in plasma and zinc levels in a very short time after the exercise period. McDonald and Keen, (1988) theorized that plasma zinc is removed from the body by increasing urination, as a result of increasing physical exercises which cause a rapid decrease of zinc and redistribution of plasma zinc into the liver. The process in which the zinc plasma is carried into the liver is thought to be an acute-phase reaction regulated by cytokines [12].

Physical exercise causing soft tissue trauma and pain is also causes zinc loss in plasma. Singh et al. studied zinc loss in plasma on soldiers who are doing a 5-d, intensive training, and taking enough zinc during the training period[19]

The oxygen demand goes 10-15 times up during a physical exercise when compared with the resting conditions. The ultimate rise in mitochondrial oxygen use causes oxidative stress. Oxidative stress causes lipid peroxidation and reactive oxygen species. Growing free radical quantity leads to muscle inflammation, muscle injuries and decrease sports performance [13].Therefore it is important to rescue body zinc level for maintaining the maximal exercise capacity.

Adding extra amount of zinc might increase anabolic hormonal profiles, decrease catabolism, and improves immune status and/or adaptation for endurance exercises. The initial data from the outcomes of the Om and Chung (1996) study suggests that basic nutritional zinc supplementation may improve the anabolic hormone profile of athletes engaging in intense physical activity. Zinc plays an essential role in androgen metabolism and interaction with steroid receptors [14] . For a few years function of Testosterone in improving physical capacity has been studied.

Bordin et al., investigated the results of extreme physical training on plasma zinc and copper levels on 19 subjects and found that copper concentration amount of plasma decreases while zinc concentration increases following the training for both sexes. There is no consensus among the zinc amount in blood and the physical exercise [1]. Some researchers believe the zinc level in blood decreases [4,21] as a result of physical exercise, while others think the opposite [6] . Van Loan investigated the relation between zinc loss and muscle function and discovered that plasma zinc level decreases %67 thanks to isokinetic extension. They also discovered that zinc loss considerably reduces muscle strength and total work capacity [21]

Copper also takes role in the function 30 enzymes. However we found no correlation between the physical exercise and the copper levels in blood after all type of exercise program [6] . Pourvaghar et al, measured the serum copper levels in athlete students for three times who performed Bruce protocol aerobic exercise on treadmill machine until they get exhausted. The first stage the blood samples was taken before exercise the second stage after doing exhausting aerobic exercise and in the third one a complete day for resting was given to the subjects. There is no meaningful difference in the copper level of the serum among all the group [17].

## V. CONCLUSİON

In conclusion the data acquired in this study are in good obedience to these researchers study. Different exercise types (IR, MS, PE) were found out that sharp and intense exercises may result in the concentrations of some elements to be more or less in blood [20]. The blood zinc levels of all the groups showed a decrease while the blood copper levels showed no statistically significant difference after all exercise types. These results indicated that our research training models (interval running, power endurance, maximal strength) could not have an effect on homeostasis of copper. Also we realized that power endurance group is better than the others at saving the zinc status of the body.

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