

ZINC SUPPLEMENTATION : A MUST FOR ATHLETES

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Zinc deficiency is a serious problem for some specific groups of athletes, particularly youngsters competing in sports. Along with sufficient amount of protein, carbohydrate and fat, the human body needs adequate amount of vitamins and micronutrients for sustenance. Among them calcium and iron have been proved to be of utter importance. Recently, focus is on the quantity of zinc in the diet, particularly for athletes, the daily time constraints of an elite young athlete can make achieving a balanced diet difficult, and puts these athletes at a potential increased risk for micronutrient deficiencies. It is a must for athletes, where the requirement should be fulfilled through proper diet along with proper supplementation to gain appropriate results.

Introduction

Zinc! Not much is written about this super microelement but is a must for athletes and for general health as well. Peak athletic performance depends on adequate zinc as well as iron and copper, according to a new study from Human Nutrition Research Center, USA.

Zinc deficiency is a serious problem for some specific groups of athletes, particularly youngsters competing in sports. Diets with very low energy content will not only provide little zinc, but will also promote zinc loss. The normal human body contains only about 2 g of zinc, mostly in muscle (about 60% of the total) and bone (about 30%). Low concentrations are present in sweat - perhaps as much as 1 mg per litre of sweat - and this may account for the concern of many athletes. There are reports that the serum zinc levels of runners and athletes are low, but more information is needed to confirm this and to establish whether or not the serum level is of any importance. There is, however, no evidence that these losses are sufficient to cause concern, even when sweat losses are very high

as can occur during periods of heavy training in hot climates. It may just be that hard endurance training shifts the zinc out of the blood into other tissues. High concentrations of zinc are present in semen, but this is neither a major source of loss nor a good source of intake.

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Zinc Deficiency

In brief, Zinc is required by the body for following functions:

(i) for the activity of more than 300 enzymes, covering all 6 classes of enzyme activity including metalloenzymes in dehydrogenases, aldolases, peptidases and phosphates (ii) regulation of cell cycle (iii) RNA and DNA functions, DNA reproduction (iv) release of vitamin

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A from liver into blood (v) rhodopsin in eye (vi) constituent of insulin (vii) helps in reproductive cycle (viii) production, storage and release of anterior pituitary (ix) cellular respiration, maintenance of cell membrane integrity and free radical scavenging.

Another aspect of zinc is its role in glucose tolerance. Zinc is closely 'involved' with insulin. When zinc is removed from diet of rats, glucose intolerance develops. While studying diabetic patients, it has been shown that many have problems absorbing zinc, and over excrete it as well. On the other hand, beneficial effects were shown after supplementation of Zinc for diabetes patients, particularly type-2 diabetics as their serum zinc level was elevated, and their glycemic control was improved and promotes healthy lipid parameters^{2,3}. The reasons for this are as yet unknown and needs investigation

Zinc deficiency has been reported to occur in only a few situations. Mostly, this is seen in people from tropical or sub-tropical regions, who live on a subsistence diet high in cereals where intake is low, absorption of the zinc in the diet is low and losses are high. Alcoholics are also at risk of zinc deficiency. Sickle cell disease is also associated with poor zinc status. Deficiency is almost unknown in healthy individuals eating a varied diet. The nutrition provided to the athletes during training and competition are entirely different from the recommended diet in most training camps. As a result of which, athletes often adopt an unusual diet in an attempt so as to enhance their performance. Sometimes, an excessive increase in carbohydrates along with low intake of proteins and fat may lead to low zinc intake in most athletes.

Symptoms of Zinc deficiency includes (i) impaired or prevention of wound healing, which may manifest as acne, eczema, xerosis (dry, scaling skin), seborrheic dermatitis, or alopecia (thin and sparse hair), oral ulceration, stomatitis, or white tongue coating, disturb the sense of smell and taste (ii) impaired growth in children and cause of delayed or stunted growth (iii) impaired immune function leading to the development of respiratory, gastrointestinal, or other infections, e.g., pneumonia. The levels of inflammatory cytokines (e.g., IL-1 β , IL-2, IL-6, and TNF- α) in blood plasma are affected by zinc deficiency and zinc supplementation produces a dose-dependent response in the level of these cytokines. During inflammation, there is an increased cellular demand for zinc and impaired zinc homeostasis from zinc deficiency is associated with chronic inflammation (iv) increased incidence and severity of diarrhea and loss of appetite (v) behavioral abnormalities, such as irritability, lethargy, photophobia and depression (e.g., involving anhedonia)

and many psychological disorders including. Schizophrenia (vi) reduced circulating testosterone, which could lead to sexual immaturity, hypogonadism, and delayed puberty⁴. In athletes, low amounts of Zinc or deficiency of zinc can lead to significant loss in bodyweight, anorexia, fatigue with decreased endurance and high risk of osteoporosis⁵.

Low dietary zinc intake has been shown to depress testosterone levels, which may be related to the decreased serum testosterone often observed in endurance athletes. Testosterone, is known to be closely interrelated with zinc. It appears that zinc may monitor testosterone metabolism at the cellular level. Although much study still needs to be done, it is also thought to control the metabolism of testosterone in the prostate. Recent studies indicate that Zinc is useful in the prevention and treatment of male infertility. Moderate deficiency of zinc can lead to regression of the sex glands in men, and just a mild deficiency causes a low sperm count. Infact, low zinc levels have been shown to lead to decreased sex drive, cause a loss of appetite and even emotional problems. Trainers, especially males, with just mild zinc deficiency, will increase their plasma levels of testosterone with supplementation. Supplementation of Zinc has been shown to have favourable effects on plasma lipid parameters by reducing total cholesterol, LDL cholesterol and triglycerides⁶. Therefore it may have the potential to reduce the incidence of atherosclerosis related morbidity and mortality.

Zinc is a common metal that has many industrial uses, but it is also essential for life. Zinc is involved as a cofactor in regulating the rate of many enzyme reactions, and an adequate supply is therefore essential for normal body function. Several of the enzymes that require zinc are involved in energy metabolism, including lactic acid dehydrogenase (LDH), which is an important component of the lactic acid energy system. Zinc also has many other roles, including promotion of tissue repair processes and maintaining the functional capacity of the cells of the immune system, which are important in fighting off infection.

Zinc Content of Various Common Foods

In the 'modern' diet very little zinc is present. Foods which used to contain high levels of zinc no longer do as zinc is now almost non-existent in crop land. The best food sources of zinc include brewers yeast, wheat bran or germ, oysters, fish, seafood, beans, red meat, poultry, soy foods, milk, whole-grains and lentils. Polished rice or processed grains may have less zinc left, but whole grains

will have more. Many breakfast cereals are also fortified with zinc. One normal sized portion of beef contains almost 10 mg of zinc and 100 grams of oysters will provide about 60 mg of zinc. Vegetarians may need up to 50% more of the Recommended Dietary Allowance (RDA) for zinc than people who do eat meat. Soaking the grains, beans, and seeds in water for several hours until sprouts form can increase zinc bioavailability in those foods. Zinc contents in various Indian foods are given in Table 1.

Table 1 : Zinc contents in various Indian foods

Food Items	Zinc (mg) per 100g
Almonds	3.0
Flax Seeds	4.0
Sunflower Seeds	5.0
Cashews	6.0
Squash and Pumpkin Seeds	8.0
Sweet Corn /Broccoli	0.5
Green Peas	1.2
Spinach	0.8
Avocados	0.6
Blackberries	0.5
Pomegranate	0.4
Apricots/Blueberries/Guavas/Peach	0.2
Egg	2.0
Crab	6.0
Oyster	60.0
Prawn	2.0
Beef	6.0
Prawn	2.0
Beef	10.0
Prawn	2.0
Chicken/Duck/Turkey	2.0
Wheat bran	7.27
Whole grain	3.36
Lentils raw/sprouted	4.78 /1.51
Cow milk	0.98

In the U.S. diet beef is the major source of this essential trace element. Athletes who avoid beef and load up on carbohydrates may fall short in zinc. Gymnasts, wrestlers and ballerinas who eat sparingly to maintain a low body weight may also be at risk of not getting enough zinc. Also, taking ‘multiple’ supplements that have zinc included, are probably doing very little good as absorption

of zinc by the body is very poor. Not all of the zinc in food is absorbed so the amount available is less than the amount eaten. The fraction that can be absorbed varies for different foods: for meat, that fraction absorbed may be as high as 60%, but high fibre cereal products have a much lower absorptive rate, perhaps only about 15% of the zinc in these foods being available. This is also because phytic acid which is present in all cereal foods inhibits zinc absorption. Hence, presence of large amounts of cereal products in the diet tends to reduce the amount of zinc that can be absorbed.

In addition to zinc supplements themselves, athletes may find that zinc is also present in other supplements that they are taking, and they should look closely at all supplements to ensure that they do not exceed the safe limit. The amounts of zinc being taken by some athletes are far in excess of the doses that are normally recommended, perhaps as much as 10 times the recommended dose. Supplemented Zinc sulfate can cause stomach irritation. Zinc gluconate and amino acid chelates of zinc are better absorbed. However, if zinc supplements are used, it is important that they are not excessive, as excess zinc in the diet can result in a secondary iron and copper deficiency leading to anemia. Moreover, long term use of zinc supplements in high dose may cause zinc toxicity and show range of symptoms, including nausea, diarrhea, headaches, decreased immunity, copper deficiency and decrease in the HDL-cholesterol level in the blood.

With these athletes in mind, physiologist Henry C. Lukaski, of Human Nutrition Research Center at Grand Forks, N. D. studied the effects of a low-zinc diet on athletic men in their twenties⁷. He focused on a zinc-containing enzyme—carbonic anhydrase—in red blood cells. “The enzyme helps red blood cells pick up carbon dioxide and drop it off in the lungs to be exhaled. This exchange helps maintain the chemical environment muscle cells need to contract and produce energy. If the exchange is sluggish, the athlete pays the price in performance” says Lukashi. For nine weeks each, the men ate a diet containing 18 milligrams of zinc per day—slightly more than the recommended amount—and another containing only 3 mg/day—one fifth of the recommendation. It was found that the men with low-zinc diet had significant drops in peak oxygen uptake and peak carbon dioxide output. Their respiratory exchange ratios also dropped, indicating energy production during peak exercise was not up to mark. The activity of the carbonic anhydrase enzyme also was lower after the low-zinc diet during exercise .

Generally, the RDA of zinc for Indians as given below in Table 2 is 12mg /day for men and 10 mg/day for women.

Table – 2 Recommended Dietary Allowances of Zinc for Indians (mg/day) ⁸

Man	12
Woman	10
Pregnant woman	12
Lactation	12
Children	
1-3 years	5
4-6 years	7
7-9 years	8
Boys 10-12 years	9
Girls 10-12 years	9
Boys 13-15 years	11
Girls 13-15 years	11
Boys 16-17 years	12
Girls 16-17 years	12

On the other hand, the National Academy of Medicine’s recommended daily allowance (RDA) in USA for zinc is 11 mg for adult men 8 mg for adult women, 11 to 12 mg for pregnant women.

It is generally agreed and recommended that, especially athletes, can take up to 30 milligrams a day, and this is considered safe, but higher levels than this are not recommended and could have adverse effects on health. It is better to take supplement copper whenever zinc is taken, about 1 milligram of copper for every 10 of zinc. It is also suggested that 50 to 200 micrograms of selenium may be taken as well.

For Indians, according to Nutrition and Hydration Guidelines for Excellence in Sports Performance⁹ - 2.41- ‘*Losses of minerals can occur from strenuous exercises. Losses of iron and magnesium are likely from sweat particularly in hot conditions. If dietary intake fails to compensate for these losses athletic performance will be adversely affected. Hence iron, zinc and magnesium supplements may be necessary. But these should not exceed 1-2 times the RDA. Excessive intake can be toxic. Female athletes who train in hot conditions are likely to lose iron and calcium. They will require calcium supplements to maintain healthy bones*’.

Wound Healing and Tissue Repair

There is good evidence that zinc is important in helping the tissue repair process that is an important part of recovery after traumatic injury. This effect of zinc on wound healing is an important fact for trainers. The processes of breakdown of damaged cells and tissues after injury and the manufacture of new tissues are in some ways similar to those that occur in training. Improving the functional capacity of muscle and other tissues requires that unwanted elements are broken down and disposed of, and that new functional elements take their place. Most of the remodeling involves changes to the proteins in tissue, but other cellular components are also involved.

Studies on young children, where rapid tissue growth is - or at least should be -taking place shows that zinc deficiency results in a failure to grow normally, combined with loss of appetite and signs of poor wound healing. In a recent study by Lin *et al.*¹⁰, on a group of patients recovering from wounds, one group was provided with 150 milligrams of zinc daily while the control group received no supplemental zinc. The group that received the zinc was completely healed in 46 days. The control group took eighty days for complete healing. This is important to weight trainers, as this type of training causes ‘damage’ which requires ‘healing’ for muscles to grow larger or stronger. Recent reports also show that Zinc appears to help in preventing progression to advanced AMD, a vision loss with age called macular degeneration¹¹.

Zinc and the Immune System

The cells of the immune system are part of the body’s defense against harmful organisms that are responsible for many of the illnesses and infections to which human are all susceptible. For most common people the colds and flu are an annoyance that soon passes given ample time, but for the athlete, the interruption to training or to preparation for competition because of cold and flu attack may be much more serious.

Few years back , study by Hemila *et al* ¹²., involving over 200 people concluded that zinc lozenges can triple the speed of recovery from a cold. However, the doses of zinc ranged from 80 to 92mg a day, which is significantly higher than the recommended daily amount (RDA) in the UK, which is 5.5-6.5mg a day for men and 4.0-7.0mg for women.

When the body detects the presence of an invading organism that can cause illness, the immune cells are

mobilised to attack and destroy the invader. The cells divide rapidly to increase their numbers and this means that there is a high demand in these tissues for the nutrients necessary to build new cells. Zinc plays a key role in this process and if it is not available in adequate amounts, the body's defense will be weakened. However, although zinc is clearly important in maintaining a strong immune system, the evidence available at present does not suggest that the athlete who takes regular zinc supplements will experience fewer episodes of minor illness than the athlete who does not take supplements.

Conclusion

Hence, zinc has a variety of functions on the body and is very much essential for maintaining health. It is a must for athletes, where the requirement should be fulfilled through proper diet along with proper supplementation to gain appropriate results. The trainers should also keep keen observation on the diet taken by the athletes or provided to them so that sufficient zinc along with other micronutrients are present in their daily meal to support them in their endeavor. □

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