COLLOIDAL ZINC

Zinc is an essential trace element for all forms of life. The significance of zinc in human nutrition and public health was recognized relatively recently. Clinical zinc deficiency in humans was first described in 1961, when the consumption of diets with low zinc bioavailability due to high phytic acid content was associated with "adolescent nutritional dwarfism" in the Middle East (1). Since then, zinc insufficiency has been recognized by a number of experts as an important public health issue, especially in developing countries

Function

Numerous aspects of cellular metabolism are zinc-dependent. Zinc plays important roles in growth and development, the immune response, neurological function, and reproduction. On the cellular level, the function of zinc can be divided into three categories: (catalytic, structural, and regulatory.

Catalytic role

Over 300 different enzymes depend on zinc for their ability to catalyse vital chemical reactions.

Zinc-dependent enzymes can be found in all known classes of enzymes.

Structural role

Zinc plays an important role in the structure of proteins and cell membranes. A finger-like structure, known as a zinc finger motif, stabilizes the structure of a number of proteins. For example, copper provides the catalytic activity for the antioxidant enzyme copper-zinc superoxide dismutase (CuZnSOD), while zinc plays a critical structural role. The structure and function of cell membranes are also affected by zinc. Loss of zinc from biological membranes increases their susceptibility to oxidative damage and impairs their function.

Regulatory role

Zinc finger proteins have been found to regulate gene expression by acting as transcription factors (binding to DNA and influencing the transcription of specific genes). Zinc also plays a role in cell signalling and has been found to influence hormone release and nerve impulse transmission. Zinc has been found to play a role in apoptosis (gene-directed cell death), a critical cellular regulatory process with implications for growth and development, as well as a number of chronic diseases

The mineral Zinc is commonly found in the retina, iris, liver, prostate, semen and hair and is associated with many metabolic processes within the body.

Zinc is an antioxidant nutrient, which aids in protein synthesis and wound healing. It is vital for the development of the reproductive organs. Zinc supports healthy prostate functions and male hormone activity. It governs the contractility of muscles, which is important for blood stability. Zinc maintains the body's alkaline balance and helps in normal tissue function and aids in the digestion and metabolism of phosphorus.

Zinc is a mineral that is essential to the synthesis of DNA and RNA, of proteins, insulin and sperm. The body needs zinc to metabolize carbohydrates, protein, fat and alcohol and to dispose of carbon dioxide and make good use of vitamin A. More than seventy different enzymes require zinc to perform their function

Nutrient interactions

Copper

Taking large quantity's of Zinc such as 50mg a day or more can interfere with bioavailability of copper

Iron

Supplemental Iron but not organic forms of Iron may decrease absorption of Zinc. This interaction is of concern in the management of iron supplementation during pregnancy and lactation and has led some experts to recommend zinc supplementation for pregnant and lactating women taking more than 60 mg/day of elemental iron/ supplemental.

Calcium

High levels of calcium may impair iron absorption but this has only been tested on animals and not humans

Folate

The bioavailability of dietary folate is increased by the action of a zinc-dependent enzyme, suggesting a possible interaction between zinc and folic acid.

Vitamin A

Zinc and vitamin A interact in several ways. Zinc is a component of retinol-binding protein, a protein necessary for transporting vitamin A in the blood. Zinc is also required for the enzyme that converts retinol (vitamin A) to retinal. This latter form of vitamin A is necessary for the synthesis of rhodopsin, a protein in the eye that absorbs light and thus is involved in dark adaptation. Zinc deficiency is associated with decreased release of vitamin A from the liver, which may contribute to symptoms of night blindness that are seen with zinc deficiency.

Severe zinc deficiency

Much of what is known about severe zinc deficiency was derived from the study of individuals born with acrodermatitis enteropathica, a genetic disorder resulting from the impaired uptake and transport of zinc. The symptoms of severe zinc deficiency include the slowing or cessation of growth and

development, delayed sexual maturation, characteristic skin rashes, chronic and severe diarrhoea, immune system deficiencies, impaired wound healing, diminished appetite, impaired taste sensation, night blindness, swelling and clouding of the corneas, and behavioural disturbances. Before the cause of acrodermatitis enteropathica was known, patients typically died in infancy. Oral zinc therapy results in the complete remission of symptoms, though it must be maintained indefinitely in individuals with the genetic disorder (6, 18). Although dietary zinc deficiency is unlikely to cause severe zinc deficiency in individuals without a genetic disorder, zinc malabsorption or conditions of increased zinc loss, such as severe burns or prolonged diarrhoea, may also result in severe zinc deficiency. Severe zinc deficiency has also been reported in individuals undergoing total parenteral nutrition without zinc, in those who abuse alcohol, and in those who are taking certain medications like penicillamine (see Drug interactions below) (19).

Marginal zinc deficiency

It is now recognized that milder zinc deficiency contributes to a number of health problems, especially common in children who live in developing countries. An estimated 2 billion people worldwide are affected by dietary zinc deficiency (20). The lack of a sensitive and specific indicator of marginal zinc deficiency hinders the scientific study of its health implications. However, controlled trials of moderate zinc supplementation

have demonstrated that marginal zinc deficiency contributes to impaired physical and neuropsychological development and increased susceptibility to life-threatening infections in young children. In fact, zinc deficiency has been estimated to cause more than 450,000 deaths in children under the age of 5 annually, comprising 4.4% of global childhood deaths.

Individuals at risk of zinc deficiency:

- Premature and low-birth-weight infants
- Older breast-fed infants and toddlers with inadequate intake of zinc-rich complementary foods
- Children and adolescents
- Pregnant and lactating (breast-feeding) women, especially adolescents
- Patients receiving intravenous feeding.
- Malnourished individuals, including those with protein-energy malnutrition and anorexia nervosa
- Individuals with severe or persistent diarrhoea
- Individuals with malabsorption syndromes, including celiac disease and short bowel syndrome
- Individuals with inflammatory bowel disease, including Crohn's disease and ulcerative colitis

- Alcoholics and those with alcoholic liver disease who have increased urinary zinc excretion and low liver zinc levels
- Individuals with chronic renal disease
- Individuals with sickle cell anaemia
- Individuals who use medications that decrease intestinal zinc absorption, increase zinc excretion, or impair zinc utilization.
- Older adults (65 years and older)
- Strict vegetarians: The requirement for dietary zinc may be as much as 50% greater for strict vegetarians whose major food staples are grains and legumes, because high levels of phytic acid in these foods reduce zinc absorption

Prevention of Diseases or Conditions Related to Zinc Deficiency

Impaired growth and development

Growth retardation

Significant delays in linear growth and weight gain, known as growth retardation or failure to thrive, are common features of mild zinc deficiency in children. In the 1970s and 1980s,
several randomized, placebo-controlled studies of zinc supplementation in young children with significant growth delays were conducted in Denver, Colorado. Modest zinc supplementation (5.7 mg/day) resulted in increased growth rates compared to placebo. More recently, a number of

larger studies in developing countries observed similar results with modest zinc supplementation. Meta-analyses of growth data from zinc intervention trials have confirmed the widespread occurrence of growth limiting zinc deficiency in young children, especially in developing countries. Although the exact mechanism for the growth-limiting effects of zinc deficiency are not known, research indicates that zinc availability affects cell-signalling systems that coordinate the response to the growth-regulating hormone, insulin-like growth factor-1 (IGF-1).

Delayed neurological and behavioral development in young children

Low maternal zinc nutritional status has been associated with diminished attention in new-born infants and poorer motor function at six months of age. Maternal zinc supplementation has been associated with improved motor development in very low-birth-weight infants, more vigorous activity in Indian infants and toddlers, and more functional activity in Guatemalan infants and toddlers. Additionally, zinc supplementation in children was associated with better neuropsychological functioning (e.g., attention) in Chinese first grade students, but this was observed only when zinc was provided with other micronutrients . Two other studies failed to find an association between zinc supplementation and measures of attention in children diagnosed with growth retardation.

Although some initial studies suggested that zinc deficiency may depress cognitive development in young children, a 2012 Cochrane review of 13 clinical trials of zinc supplementation in infants and children found no evidence that zinc supplementation improves mental or motor development.

Impaired immune system function

Adequate zinc intake is essential in maintaining the integrity of the immune system, specifically for normal development and function of cells that mediate both innate (neutrophils, macrophages, and natural killer cells) and adaptive (B-cells and T-cells) immune responses.

Moreover, zinc plays a structural role in the antioxidant enzyme, CuZnSOD (s. Zinc deficiency adversely affects a number of immune functions, resulting in decreased production of certain cytokines; reduced activation of zinc-dependent enzymes and transcription factors; and decreased activity of thymulin, a zinc-dependent thymic hormone important for T-cell function. Consequently, zinc-deficient individuals are known to experience increased susceptibility to a variety of infectious agents.

Increased susceptibility to infectious disease in children

Diarrhoea: It is estimated that diarrheal diseases result in the deaths of over 1.8 million children under five years of age in developing countries annually (. The adverse effects of zinc deficiency on immune system function are likely to increase the susceptibility of children to infectious diarrhoea, and persistent diarrhoea contributes to zinc deficiency and malnutrition. Research indicates that zinc deficiency may also potentiate the effects of toxins produced by diarrhoea-causing bacteria like *E. coli* .

Zinc supplementation in combination with oral rehydration therapy has been shown to significantly reduce the duration and severity of acute and persistent childhood diarrhoea and to increase survival in a number of randomized controlled trials (. A 2007 meta-analysis of randomized controlled trials concluded that zinc supplementation reduces the frequency, severity, and duration of diarrheal episodes in children under five years of age.

More recent meta-analyses have found beneficial effects of zinc supplementation were limited to children older than 6 or 12 months. The World Health Organization and the United Nations Children's Fund currently recommend zinc supplementation as part of the treatment for diarrheal diseases in young children.

Pneumonia: Zinc supplementation may also reduce the incidence of lower respiratory infections, such as pneumonia. A pooled analysis of a number of studies in developing countries demonstrated a substantial reduction in the prevalence of pneumonia in children supplemented with zinc. Two meta-analyses have found that zinc supplementation reduces the incidence of pneumonia or respiratory tract illnesses in children less than five years of age (4. However, it is not clear whether supplemental zinc, in conjunction with antibiotic therapy, is beneficial in the treatment of pneumonia.

Malaria: Some studies have indicated that zinc supplementation may reduce the incidence of clinical attacks of malaria in children. A placebo-controlled trial in preschool-aged children in Papua New Guinea found that zinc supplementation reduced the frequency of health centre attendance due to *Plasmodium falciparum* malaria by 38% . Additionally, the number of malaria episodes accompanied by high blood levels of this malaria-causing parasite was reduced by 68%, suggesting that zinc supplementation may be of benefit in preventing more severe episodes of malaria. However, a six-month trial in more than 700 West African children did not find the frequency or severity of malaria episodes caused by *P. falciparum* to be different in children supplemented with zinc compared to those given a placebo. Additionally, a randomized controlled trial reported

that zinc supplementation did not benefit preschool-aged children with acute, uncomplicated *P. falciparum* malaria. Further, a randomized controlled trial in over 42,000 children aged one to 48 months found that zinc supplementation did not significantly reduce mortality associated with malaria and other infections (54). Due to conflicting reports, it is not yet clear whether zinc supplementation has utility in preventing or treating childhood malaria (28).

Pregnancy complications

It has been estimated that 82% of pregnant women worldwide are likely to have inadequate zinc intakes. Poor maternal zinc nutritional status has been associated with a number of adverse outcomes of pregnancy, including low birth weight, premature delivery, labour and delivery complications, and congenital anomalies. However, results of maternal zinc supplementation trials in the US and developing countries have been mixed. Although some studies have found maternal zinc supplementation increases birth weight and decreases the likelihood of premature delivery, two placebo-controlled studies in Peruvian and Bangladeshi women found that zinc supplementation did not affect the incidence of low birth weight or premature delivery. Supplementation studies designed to examine the effect of zinc supplementation on labour and delivery complications have also generated mixed results, though few have been conducted in zinc-deficient populations.

A recent systematic review of 20 randomized controlled trials found that zinc supplementation during pregnancy was associated with a 14% reduction in premature deliveries; the lower incidence of preterm births was observed mainly in low-income women. This analysis, however, did not find zinc supplementation to benefit other indicators of maternal or infant health.

HIV/AIDS:

Sufficient zinc is essential in maintaining immune system function, and HIV-infected individuals are particularly susceptible to zinc deficiency. In HIV-infected patients, low serum levels of zinc have been associated with a more advanced stage of the disease and also with increased mortality. In one of the few zinc supplementation studies conducted in AIDS patients, 45 mg/day of zinc for one month resulted in a decreased incidence in opportunistic infections compared to placebo. HIV-positive adults with low plasma levels of zinc (<0.75 mg/l) found that zinc supplementation (15 mg/day for men and 12 mg/day for women) for 18 months reduced the incidence of immunological failure (defined by a CD4+ count <200 cells/mm3) by 76% and the rate of diarrhoea by 60%.

Zinc is a component of SOD's; it stops absorption of lead, cadmium and is essential for RNA and DNA synthesis.

It restores the rate of healing, reduces prostate, improves bone density in postmenopausal women, and

restores gastro intestinal system, which includes taste and smell.

Low levels of zinc are associated with lung cancer, diabetics, Anorexia, Crohn's disease, Alopecia, skin infections, ulcers, skin disorders and sickle cell, Decreased macular degeneration by 70% and cataracts.

Suggested dosage: 15 -25 ml before bedtime

Colloidal Zinc absorbs 100%

In comparison to tablets which is 10%

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