

Importance of Zinc and Zinc Deficiency

By Prof. Joachim Schmidt

Zinc is an essential trace element that has to be constantly supplied to the body in adequate amounts. According to the guidelines of the German Society for Nutrition, a daily intake of 10 mg of elemental zinc for adolescents and adult men and 7 mg for women is recommended. Pregnant women and nursing mothers have a greater need and should take 10 or 11 mg/per day. Depending on their age, children need 3-7 mg daily.

Although zinc is found in almost all foods and therefore a sufficient intake would actually be expected from food, nutritional studies have shown that more than 20% of the population receive too little zinc. The National Nutrition Survey II (2008) showed that in Germany, depending on age and sex, 17-44% of people take in less zinc than recommended by the guidelines. The elderly are particularly at risk. Of men aged 65-80 years, 44.2% had an inadequate zinc intake. Reasons for the decreasing supply of zinc are mainly the increased consumption of industrially processed foodstuffs, which are therefore mostly low in zinc, such as polished rice, finely-ground flour and reduced meat consumption. A typical zinc-deficient diet would consist of white bread, fat and cola. In addition, there are age-related reductions in zinc absorption in the intestine and other risk factors. The most common causes of zinc deficiency are:

- inadequate dietary intake
- absorption disorders in the intestines
- malabsorption after intestinal resection or other bowel diseases
- inhibited absorption due to food constituents and complexing agents (e.g. phytates) that inhibit the uptake of zinc
- diseases of the intestine
- dysfunction of the liver or pancreas
- congenital disorder (acrodermatitis enteropathica)
- increased losses
- diarrhoea
- increased excretion in the urine (in liver cirrhosis, diabetes mellitus, kidney diseases, trauma, infections and as a result of diuretics)
- increased demand (e.g. pregnancy, breastfeeding, competitive sports).

Groups at risk for zinc deficiency are mainly:

- children and adolescents
- pregnant and breastfeeding women
- vegetarians
- the elderly
- those who have recently undergone surgery and who are recovering from illness
- patients with intestinal diseases (condition after bowel resection, intestinal fistula, Crohn's disease, ulcerative colitis, Whipple's disease)

- alcoholics
- competitive athletes

Since zinc is involved in a variety of biochemical functions in the enzyme, protein, nucleic acid and hormone metabolism, as well as the immune system, a deficiency can lead to the weakening of various body functions and therefore to multiple effects. The following are the main deficiency symptoms:

- growth disorders
- delayed wound healing
- dermatological diseases (hair loss, skin and mucosal damage)
- disorders of the sensation of smell and taste
- endocrinological disorders (e.g. glucose utilisation disorders in diabetes mellitus)
- fertility disorders / hypogonadism
- disorders of the immune system with increased susceptibility to infection
- neurological disorders (irritability, depression).

Zinc deficiency is difficult to detect in practice with routine methods of laboratory analysis. The determination of zinc levels in the blood (plasma) does not provide any conclusive results. Zinc in serum or whole blood (EDTA blood) is in the normal range in 90% of all cases of zinc deficiency. The normal range is much broader than the set point for individual zinc homeostasis, the individual serum standard for zinc. The body tries to keep the serum zinc constant at this value. There are only small deviations from the individual standard even in cases of a major deficiency, but all still lie within the laboratory standard and are therefore not recognised as a zinc deficiency. A decline in serum zinc under the laboratory standard is often observed only in very severe forms of zinc deficiency. The examination of tissue samples would be more reliable, but this is not very suitable for therapeutic practice. In addition, the activity of alkaline phosphatase, the determination of the zinc concentration in the serum after zinc supplementation and the zinc-binding capacity are meaningful parameters. Overall, however, the development of a method for clinical practice, displaying the zinc status quickly and reliably, is still urgently required.

For the prevention and treatment of zinc deficiency, a zinc supplement of 10-25 mg of elemental zinc per day is recommended. Higher doses are not necessary in the majority of cases and may even be harmful with prolonged use. Specific dosage requirements exist in acrodermatitis enteropathica and when zinc is used for the treatment of Wilson's disease. Higher doses are required in these cases.

The extensive physiological role of zinc is such that not only a deficiency, but also the excessive intake of zinc can lead to health problems. The upper intake level (maximum level) at which according to international assessments no damage is expected even with longer-term ingestion (tolerable upper intake level [UL]) is set at 25 mg/day for zinc. Within the therapeutic dose range therefore, no side effects generally need to be feared. In very rare cases (isolated cases) there may be hypersensitivity reac-

tions or gastrointestinal complaints in the form of nausea, vomiting, diarrhoea and stomach irritation symptoms.

The acute form of zinc intoxication occurs only when very high zinc doses (> 200-400 mg of zinc) are ingested. This leads to nausea, vomiting, gastrointestinal cramps, diarrhoea, headaches and loss of appetite.

The longer-term (over several months) intake of zinc in doses above 25-50 mg/day may cause disorders of the copper status, disorders of the iron balance, impairment of immune function and disorders of lipid metabolism (lowering of HDL cholesterol). This can lead in the long term to anaemia and cause disorders of the immune system.

Furthermore, it should be noted that zinc can lead to interactions with other foodstuffs and with some drugs:

- The simultaneous administration of zinc and phosphates, iron, copper and calcium salts can reduce the absorption of zinc, and zinc may impair the availability of copper, as well as reducing the uptake and storage of iron.
- Chelating agents such as D-penicillamine, dimercaptopropanesulphonic acid (DMPS), dimercaptosuccinic acid (DMSA) or ethylenediaminetetraacetic acid (EDTA) may reduce the absorption of zinc or increase excretion.
- Zinc reduces the absorption of tetracyclines, ofloxacin and other quinolones (e.g. norfloxacin, ciprofloxacin). For this reason, an interval of at least 3 hours should be observed between the intake of zinc and the medicines mentioned.

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