Zinc Deficiency in Populations: Aetiology, Adverse Health Consequences and Possible Solutions

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INTRODUCTION

Zinc (Zn) is required for the activity of over 200 enzymes involved in most major metabolic pathways, and thus is necessary for a wide range of biochemical, immunological, and clinical functions. As a result, multiple functions in the body are affected by Zn deficiency.

AETIOLOGY, ADVERSE HEALTH CONSEQUNCES, AND ASSESSMENT

Major factors associated with the aetiology of Zn deficiency in populations include inadequate intakes arising from low intakes or poor bioavailability of dietary Zn; physiological states increasing Zn requirements (e.g., during infancy, adolescence, pregnancy, and lactation), and disease states inducing excessive losses (e.g., diarrhoea) or impaired utilization. The potential for inadequate intakes of dietary Zn is exacerbated in countries where plant-based staples are grown on low-Zn soils.

Randomized controlled trials have confirmed that the health consequences of Zn deficiency are impairments in growth and immune function, an increased risk of diarrhoea, respiratory diseases, and mortality during childhood, and an increased risk of preterm infants in underweight pregnant women with low Zn intakes. Disturbances in neuro-behavioural development may also occur (Brown and Hess, 2009).

Risk of Zn deficiency can be identified at the population level by assessing the prevalence of (a) inadequate dietary Zn intakes, (b) low serum Zn concentrations, and (c) stunted children < 5 years of age; trigger levels indicative of public health concern are > 25%, >20%, and > 20%, respectively. Carefully collected and measured serum/plasma Zn concentrations in a population are useful because they reflect dietary Zn intakes, and respond consistently to Zn supplementation. Sub-population groups identified as at risk using these indicators are often breastfed infants $\geq$ six months of age, preschool children, pregnant and lactating women, and the elderly.

POSSIBLE STRATEGIES TO COMBAT ZINC DEFICIENCY

Strategies to combat Zn deficiency include Zn supplementation, fortification, dietary diversification/modification and biofortification, the choice depending on the magnitude of risk, life-stage group, and setting. Zn supplementation is recommended by WHO/UNICEF for the treatment of acute diarrhea, and by IZiNCG as a preventive measure for stunting, diarrhea, and pneumonia in high risk children, and to prevent preterm births among high risk pregnant women (Brown and Hess, 2009). For urban households, both national and targeted fortification of cereal staples for infant and young child feeding can be used. Diversification/modification and biofortification are more accessible to the rural poor who consume staple foods from local or self-production. Further, these strategies have the potential to enhance Zn status of the entire household and across generations. Dietary diversification/modification can be designed to increase the consumption of both Zn-rich foods and Zn absorption enhancers, while simultaneously reducing phytate, a potent inhibitor of Zn absorption. Biofortification can be achieved by applying Zn fertilizers to Zn-

deficient soils to enhance the Zn content of cereal staples, using conventional plant breeding to increase the Zn concentrations of wheat or rice, or alternatively, genetic modification to increase the Zn concentration in maize. To maximize the effectiveness of these interventions, attention should be given to monitor their delivery, utilization, and impact, and to integrate them with public health and behaviour change strategies.

REFERENCES

Brown, K.H. and Hess S.Y. (Ed) (2009). Supplement. International Zinc Nutrition Consultative Group Technical Document # 2. Systematic Reviews of Zinc Intervention Strategies. *Food Nutr. Bull.* 30: S5-S184.