President's Page

Propagation of Zinc for Improving Child Health

Zinc is a constituent of more than 70 metalloenzymes including major enzyme-classes (oxidoreductases, transferases, hydrolases, lysases, isomerases and ligases). Chelation of zinc with the amino acids cysteine and histidine forms 'zinc fingers' which are important for transcription of proteins. Additional processes that are regulated by zinc include expression of the metallothionein gene, apoptosis and synaptic signaling. Due to these diverse functions, zinc plays a critical role in growth and development, cellular integrity, and many biological functions including protein synthesis, nucleic acid metabolism and immune function(1). Though the adverse effects of severe zinc deficiency in humans are recognized for long, researchers recently have explored the benefits of zinc in a wide variety of childhood conditions including diarrhea and acute respiratory infections. The potential benefit of zinc in these conditions is mediated via a variety of pathways including stabilization of the epithelial barrier, and function of neutrophils, natural killer cells, monocytes, and macrophages.

Although severe zinc deficiency is rare, it is estimated that mild to moderate deficiency is common in developing countries(2). However, in the absence of a reliable marker for zinc deficiency, there is no direct evidence for this estimate. The reasons for high prevalence of zinc deficiency in developing world are lack of intake of animal foods, high dietary phytate content interfering with its bioavailability, inadequate food intake and increased fecal losses during episodes of diarrhea. Since the currently available methods do not provide a reliable estimate of the magnitude of the defi-ciency, it has been suggested that supplementation trials should be relied upon to define the extent of zinc deficiency. The role of zinc supplementation has been investigated in prevention or treatment of adverse fetal outcomes, diarrhea, pneumonia and malnutrition and in improving childhood growth and development.

Regarding prevention of adverse fetal outcomes, prenatal zinc supplementation trials have failed to document a consistent benefit on fetal growth, duration of gestation, and immediate neonatal survival(3). With respect to neurobehavioral development, evidence is conflicting. Recent data and some preliminary findings indicate a beneficial effect of maternal zinc supplementation on neonatal immune status and infant morbidity from infectious diseases(4). The most significant results of role of zinc in improving child survival have come from its use in childhood diarrhea. The result of pooled analyses of zinc supplementation trials in children between the ages of 6 months to 3 years demonstrated a 15% (95% CI 4% to 24%) faster recovery and 22% (95% CI 9% to 34%) reduction in odds of an episode lasting for more than 7 days(5). Since most of these studies were conducted from developing countries including India, Indian Academy of Pediatrics took lead in endorsing the use of zinc preparations during episodes of acute diarrhea. The IAP task force first gave its recommendations in 2004 and encouraged the industry to prepare zinc formulations containing only zinc(6). These preparations are now widely available on prescription in the market and IAP is making efforts to promote their use in acute diarrhea along with other child survival interventions by conducting workshops all over India. Apart from diarrhea, limited evidence shows benefit of zinc supplementation in prevention and treatment of pneumonia(7). However, further sound data is required for qualifying its use in treatment of other infective diseases like pneumonia and malaria. Some trials with infants have examined zinc supplementation and development. Trials of zinc given alone have shown inconsistent findings, possibly because in some studies the children might not have been zinc deficient, other nutrient deficiencies affected development, or because zinc produced imbalances in other micronutrients(8). The effect of zinc deficiency on child development therefore remains unclear.

A word of caution! Though zinc supplementation has been shown to be beneficial in several childhood conditions mainly diarrhea, the magnitude of benefit

is likely to be modest. Zinc should not be perceived as a magic bullet for cure of all ailments. Other simultaneous interventions like use of ORS in diarrhea, antibiotics in pneumonia and dietary interventions for malnutrition should take precedence. Additional problems such as iron deficiency or poor environments also need simultaneous improvement. Also, medicinal zinc should be perceived only as a short-term solution. In the long term, improved dietary quality and intake, food fortification and cultivation of zinc dense plants should be relied upon to combat zinc deficiency.

REFERENCES

1. Vallee BL, Falchuk KH. The biochemical basis of zinc physiology. Physiological Reviews 1993; 73: 79-118.
2. Kapil U, Pathak P, Singh P, Singh C. Zinc and magnesium nutriture amongst pregnant mothers of urban slum communities in Delhi: a pilot study. Indian Pediatr 2002; 39: 365-368.
3. Shah D, Sachdev HPS. Zinc deficiency in pregnancy and fetal outcome. Nutr Rev 2006; 64: 15-30.
4. Osendarp SJ, West CE, Black RE. The need for maternal zinc supplementation in developing countries: An unresolved issue. J Nutr 2003; 133: 817S-827S.
5. Bhutta ZA, Black RE, Brown KH, Gardner JM, Gore S, Hidayat A, *et al*. Therapeutic effect of oral zinc in acute and persistent diarrhea in children in developing countries: pooled analysis of randomized controlled trials. Am J Clin Nutr 2000; 72: 1516-1522.
6. Bhatnagar S, Bhandari N, Mouli UC, Bhan MK. Consensus statement of IAP National Task Force: Status report on management of acute diarrhea. Indian Pediatrics 2004; 41: 335-348.
7. Bhutta ZA, Black RE, Brown KH, Gardner JM, Gore S, Hidayat A, *et al*. Prevention of diarrhea and pneumonia by zinc supplementation in children in developing countries: pooled analysis of randomized controlled trials. J Pediatr 1999; 135: 689-697.
8. Walker SP, Wachs TD, Gardner JM, Lozo B, Wasserman GA, Pollit E, *et al.* Child development: risk factors for adverse outcomes in developing countries. Lancet 2007; 369: 145-157.

Naveen Thacker,
President, IAP 2007,
Deep Children Hospital,
208, Sector 1-A,
Gandhidham, Kutch 370201,
Gujarat, India,
E-mail: presidentIAP2007@iapindia.org