Zinc Supplementation in the Treatment of Childhood Diarrhoea

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Diarrhoea is major cause of childhood death and malnutrition in most of the developing as well as developed countries. The public health importance of control of diarrhoeal diseases is well recognised by World Health Organization, International health promoting agencies and Governments of various countries. Yet, it is critical to identify the important determinants of diarrhoeal diseases and initiate appropriate measures to reduce the incidence and severity of diarrhoeal illness. Children are most vulnerable to diarrhoeal illness due to its direct and indirect effects. Diarrhoea causes death due to dehydration and complications, but for vast majority of diarrhoea affected children, recovery is the usual outcome. The after effects of diarrhoea episodes have received relatively less attention but malnutrition is one which has been taken with importance.

The mechanism of causation of malnutrition has been incompletely understood, as many issues on nutrition have remained unclear. There are substantial wealth of information to believe that in children, nutritional status is a determining factor for severity of diarrhoeal episodes, whereas most of studies could not document that incidence of diarrhoea has any clear relationship with nutritional status.

While anthropometric index of nutritional status has been taken as a proxy indicator of micronutrient status of individual, until recently this view has not been challenged. There are evidences now to assume that even in normal to mild malnutrition, trace element deficiency could exist, which has been related to inadequate dietary intake, inappropriate dietary habit and various metabolic disorders. Along with the macronutrients i.e., fat, protein, carbohydrate, micronutrients are essential for growth and normal physiological function of children. Among the micronutrients, trace elements are important because of their essential functions despite the small amount required. Trace element deficiencies in children of most developing countries are related to their inabundance in the common food items.

Among the essential micronutrients for growth and morbidity, zinc has been known for long for its integral presence in more than 100 metaloenzymes which are regularly needed for protein synthesis, bone mineralization, physical growth and biological functions including immunocompetence.

Role of zinc in maintenance of physiological functions

Severe zinc deficiency has been labelled as 'Acrodermatitis enteropathica' (AE) presented with severe diarrhoea, severe infec-
tion, erethematous skin lesions, alopecia, oral and anal scoriation and Moynehan reported that this severe disease condition could be returned to normal by zinc supplementation. Zinc deficiency in experimental animals causes diarrhoea. AE is an inherited autosomal recessive trait where severe diarrhoea, alopecia, skin lesion and frequent infection constitute a life threatening syndrome. Complete recovery and reversal of the mucosal abnormality, after large doses of oral zinc supplementation, has been reported. Information on the relationship between zinc deficiency and diarrhoea in children is limited although, evidence of zinc deficiency in severely and marginally malnourished children has been reported recently. The role of zinc in diarrhoea may be mediated through several mechanisms which include, membrane stabilization, mucosal integrity, electrolyte transport, water transport, immunocompetence, protein and essential enzyme synthesis. Several of these phenomena have been studied in animal models in the laboratory and some have been observed in supplementation studies in children with malnutrition and diarrhoea.

Factors that affect body zinc status include; nutritional status: severity and duration of diarrhoea, presence of systemic diseases, extent of small bowel enteropathy, absorption of zinc before or during diarrhoea, extent of pre-existing zinc deficiency, adequacy of dietary intake of zinc, bio-availability and utilization in the body. The maintenance of integrity of the mucosal cell membranes, repair of mucosal injury by increased protein synthesis, multiplication of epithelial cells, and improvement in sodium and water transport are likely to reduce fluid loss during diarrhoea. Repair of mucosal paracellular tight junctions would allow better absorption of water. The improvement in immunological function especially on secretory IgA and T-lymphocytes would be expected to limit the growth and multiplication of diarrhoeal pathogens within the intestinal lumen. Thus the physiological, ultrastructural and immunological role of zinc mentioned above offers a set of mechanisms which may explain why there may be a reduction in diarrhoeal severity and duration. The therapeutic effect of zinc is likely to be more in the subjects who are zinc deficient.

Role of zinc in water and electrolyte transport

Ultrastructural abnormalities in experimental zinc deficient animals have been described in intestinal paneth cells including crystalloid secretory granules, giant granules and dilated golgi vesicles, cytoplasmic vacuolation, few endoplasmic reticulum, mitochondria and ribosomes. Functional abnormalities of sodium and water transport have been described in experimental studies. An in-vivo singlepass perfusion study showed that net water and sodium transport from the small intestine of zinc-deficient rats was significantly decreased compared to corresponding mean values of pair-fed controls and ad libitum fed rats. These results are in agreement with other studies showing decreased sodium transport in leukocytes and renal tubules of zinc deficient animals and suggest that zinc may have a role in modulating membrane permeability. Changes in rat small intestine in zinc de-