Assessment of Human Zinc Deficiency and Determinants in Pakistan: Implications for Interventions

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Despite widespread stunting and the high dietary phytate content in the average diet, there are few data on the prevalence of Zn deficiency in Pakistan. We evaluated serum-Zn concentrations on a nationally representative sample of 5800 women of reproductive age and children (Agegroup: < 5 years). The assessment revealed that almost a third of children and 40% of mothers had serum-Zn concentration below 60 µg dl^{-1}, and that the prevalence was greater in rural populations (Fig. 1).

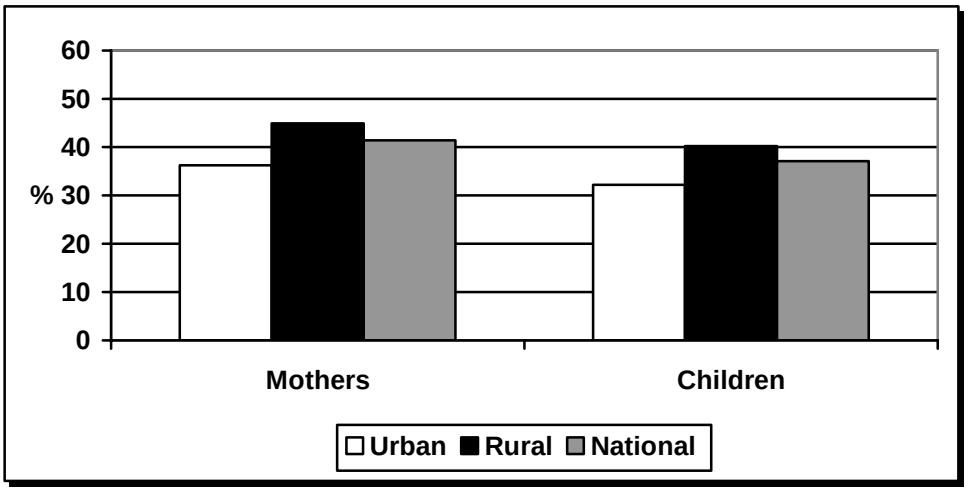

Fig. 1. Prevalence of Zn deficiency in children (under five years old) and their mothers in 2001-2002.

We also evaluated prospectively risk factors for Zn deficiency in two urban and rural cohorts of weaned infants. Quantitative assessment of intake of Fe and Zn from commonly consumed weaning diets indicated that dietary Zn and Fe intakes were very low (1.2 mg day^{-1} in young infants, 1.9 mg day^{-1} in older infants). These values are below the Recommended Dietary Allowances (RDAs) and are accompanied by a high phytate content of the diet and high burdens of diarrhea and respiratory infections. Additional information available from commonly consumed complementary foods and soil-Zn content indicates that relatively few diets for young children provide the requisite amounts of Zn needed for replenishment and prevention of deficiency, thus placing constraints on dietary diversification and behavior change strategies (Table 1).

Table 1. Average daily intake and estimated absorption of Zn (mg/day) from commonly consumed complementary foods by young infants (6-12 months) in Pakistan.

	Zinc (Absorbed)	Zinc (Absorbed)
Age group	**6-8 months**	**9-12 months**
Khitchri [Rice-lentils]	0.8 (0.4)	1.4 (0.7)
Sago Dana [Sabo grain]	0.1 (0.05)	0.1 (0.05)
Dallia [Wheat porridge]	0.2 (0.1)	0.4 (0.2)
Kheer or Firni [Rice Pudding]	0.2 (0.1)	0.5 (0.25)
Suji Kheer (Suji & Milk)	0.1 (0.05)	0.2 (0.1)
Suji Halwa (Suji, Sugar & Oil)	0.1 (0.05)	0.2 (0.1)
Banana Kheer (Banana, milk & sugar)	0.1 (0.05)	0.1 (0.05)
Potato Kheer (Potato, milk & sugar)	0.1 (0.05)	0.2 (0.1)
Mixed Diet [Potato, Lentils, Spinach, Oil]	0.7 (0.35)	2.0 (1.0)

Thus, there is an urgent need to evaluate additional intervention strategies, such as bio-fortification, the development of wheat varieties with increased Zn levels of the grain or the soil replenishment using Zn fertilizers, as well as home fortification with micronutrients. Our most recent results show that two foliar applications of 2.7 kg of $ZnSO_4$ ha^{-1}, applied before and after heading of wheat, can increase Zn concentrations of the wheat grain from 38 to 64 ppm (64% increase), but yield was reduced by 8% (500 kg ha^{-1}) (Ortiz-Monasterio et al. 2006). By reducing the $ZnSO_4$ concentration of these two foliar applications, we are optimistic that we will not affect yield and may be able to increase grain-Zn concentration by 10 ppm, in other words from 38 to 48 ppm. In addition, Zn-soil application is another strategy that should allow us to apply relatively high amounts of Zn without yield reduction and with significant increases in Zn concentrations of the grain. We will present potential impact estimates using these strategies on Zn intake patterns during childhood.

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