NUTRITION & IMPACT

Prevalence and Consequences of Mineral and Vitamin Deficiencies and Interventions to Reduce Them

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Prevalence: As a result of consistently consuming monotonous diets based predominantly on staple crops such as maize, wheat, rice, cassava, etc., which provide large amounts of energy but relatively low amounts of essential vitamins and minerals, people develop nutritional deficiencies that render them unable to produce the bioactive molecules needed for proper physical, mental, and cognitive development and optimal income-generating work. From a social perspective, populations affected by vitamin and mineral deficiency at levels that affect public health cannot achieve their economic potential. Roughly more than one-third of the world's population is at risk of one or more micronutrient deficiencies. The most common trace element deficiencies in order of prevalence are iron (~1. 6 million) (1); iodine (~2. 0 billion) (2); and zinc (~1. 5 billion) (3). The most widely prevalent vitamin deficiencies of public health significance are vitamin A with 190 million preschool children and 19 million pregnant women at risk (4), folate, and B12.

The estimated regional prevalence of three principal micronutrient deficiencies is described in the table below. It should be noted, however, that in these populations, the poorest bear the brunt of preventable mental disability and diminished physical performance, maternal and fetal-child deaths, and other long-term negative effects that constrain socioeconomic development. The lack of each nutrient deteriorates human health independently, but their combination undermines the potential of human capital at both the individual and collective levels and is difficult to measure accurately.

Regional Prevalence of Micronutrient Deficiencies

WHO Region	Vitamin A Deficiency[1]		Anemia (Proxy for Iron Deficiency)[2]			Iodine[3]
	Preschool-age children	Pregnant women	Preschool-age children	Pregnant women	Non-pregnant women	School-age children
Africa	44.4	13.5	67.6	57.1	47.5	40.8
Americas	15.6	2	29.3	24.1	17.8	10.6
Europe	19.7	11.6	21.7	25.1	19	52.4
Eastern Mediterranean	20.4	16.1	46.7	44.2	32.4	48.8
South-East Asia	49.9	17.3	65.5	48.2	45.7	30.3
Western Pacific	12.9	21.5	23.1	30.7	21.5	22.7
Global	33.3	15.3	47.4	42	30.2	31.5

[1] Global Prevalence of Vitamin A deficiency in populations at risk 1995-2005; WHO Global Database on Vitamin A Deficiency
[2] Worldwide Prevalence of Anaemia 1993-2005, World Health Organization, 2008
[3] Iodine Deficiency in 2007: Global progress since 2003; World Health Organization, 2008

Consequences: The adverse sequelae of these deficiencies are profound and include premature death, poor health, blindness, growth stunting, mental retardation, learning disabilities, and low work capacity. The negative effects of micronutrient deficiencies damage human capital and national economic development, particularly in developing countries.

The health issues associated with the most common micronutrient deficiencies (i.e., vitamin A, iron, and zinc) are:

- **Vitamin A:** Blindness, impaired immune system function, abnormal fetal development, increased child mortality, and increased maternal mortality
- **Iron:** Iron deficiency anemia, reduced cognitive capability, reduced physical capacity and productivity, increased maternal mortality, complications with childbirth, and increased infant mortality
- **Zinc:** Decreased resistance to infectious diseases, stunting and impaired growth in children, and increased infant and child mortality
- **Iodine:** Impaired mental development and brain damage, lower birth weight, and increased infant mortality

Interventions: The consequences of micronutrient deficiencies are undoubtedly tragic for individuals and families. The other dimension of this tragedy is the fact that most of these consequences can be prevented by currently available, cost-effective interventions. Traditionally, interventions to prevent micronutrient malnutrition have been grouped into medicinal (supplementation), food-based (food fortification, homestead food production, biofortification), nutrition education, and public health interventions (environmental sanitation, deworming, malaria control, etc.). More pragmatically, large-scale micronutrient interventions can be classified based on the level of scientific evidence underpinning them, as follows (5):

1) **Interventions with strong evidence of effective implementation and impact at large-scale** (i.e., preschool vitamin A supplementation, mass fortification of salt with iodine, sugar fortified with vitamin A, and wheat flour fortified with folic acid);

2) **Micronutrient interventions needing further confirmation of implementation effectiveness and impact** (i.e., maternal iron and folic acid supplementation and mass iron fortification programs); and

3) **Emerging micronutrient interventions that hold promise but lack implementation experience at large scale** (i.e., home-based fortification and biofortification)

There is no single magic bullet for populations living in poverty, hunger, social marginalization, unsanitary environments, and low quality/coverage health services. In practice, distinct combinations of available evidence-based interventions are necessary to address the problem effectively and sustainably in different socioeconomic and cultural contexts. Supplementation should be a short-term intervention for individuals and population groups during particularly high-risk phases of the life cycle (for example, iron for pregnant women and iron and vitamin A for children under two years of age). Enhancing the vitamin and mineral content of staple foods and widely consumed condiments will improve a given population’s general micronutrient status and provide the necessary reserves to meet normal day-to-day requirements and prevent deficiency when more is needed. The best and lasting solution to eliminating undernutrition as a public health problem in developing countries is to permanently consume a range of nutrient-rich staple and non-staple foods—food and nutrition security for all. Until that is achieved, biofortification of staple foods has the potential to lift the micronutrient intake for millions of people at no additional cost to consumers.

Micronutrient deficiency control and prevention programs should be tailored to existing country capabilities, and plans for sustained intervention should use multiple strategies (such as supplementation, fortification, food-based approaches, and public health measures) and address multiple micronutrient deficiencies. Because the nutrition status of all populations is in flux and groups are on a continuum of nutritional risk (from severe malnutrition, through several stages of nutrient adequacy, to nutrient overload and toxicity at the opposite end), micronutrient programs should aim to move at-risk groups from a phase of public health risk to states of sufficiency and health.

1. de Benoist, B; et al. 2008. *Worldwide prevalence of anaemia 1993-2005*. Gevena: World Health Organization.
2. de Benoist, B; et al. 2008. Iodine deficiency in 2007: Global progress since 2003. *Food Nutrition Bulletin* 29(3):195–202.
3. Hotz, C; Brown, KH. 2004. International Zinc Nutrition Consultative Group (IZiNCG), technical document no. 1: Assessment of the risk of zinc deficiency in populations and options for its control. *Food Nutrition Bulletin* 25(1):S94–204.
4. WHO. 2009. *Global prevalence of Vitamin A deficiency in populations at risk 1995-2005: WHO database on vitamin deficiency*. Geneva: World Health Organization.
5. Klemm, RDW; et al. 2009. *Scaling up micronutrient programs: What works and what needs more work?* The 2008 Innocenti Process. Washington, DC: Micronutrient Forum.