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The Role of fortification and supplementation in mitigating the 'hidden hunger'

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Abstract

Micronutrients are nutrients required by the body in small amounts for normal physiologic functions. Despite the minuscule demand for micronutrients by the body, their deficiency results in a number of health complications. Globally, more than 2 billion people are affected by micronutrient deficiency where developing world takes most of the burdens.

To make things worse, micronutrient deficiency often goes unnoticed for a long time in individuals before symptoms become apparent. Large scale interventions through fortification of foods and supplementation of micronutrients to circumvent the devastating consequences of micronutrient deficiencies are showing a great progress by reducing the number of morbidity and mortality attributed to them.

At international scale, fortification of salt with iodine, iron and vitamin A supplementation to the most risky and vulnerable groups is considered the most successful micronutrient interventions to date.

Keywords: Micronutrients; Fortification; Supplementation; Hidden hunger

Introduction

Micronutrients are non-energy yielding class of nutrients such as vitamins and minerals that are needed, and therefore consumed, in small amounts, milligrams or micrograms daily, for ensuring optimal health and well-being. Since they are not synthesized by the body at all or in adequate amounts, they should be provided through diet [1]. Micronutrients have enormous health significance. It takes part in a variety of biological functions such as regulating enzyme and hormone actions, gene expression, cellular proliferation and differentiation, growth and development, and immune modulation. They are essential for the metabolism and utilization of the macronutrients [2].

Micronutrient deficiency, often, goes unnoticed within a community in spite of their insidious effects on immune system functioning, growth and cognitive development. It is for these reasons that micronutrient deficiencies have been referred to as "hidden hunger". In individuals following popular diet plans, as suggested with food alone, there is high likelihood of becoming micronutrient deficient; a state shown to be scientifically linked to an increased risk for many dangerous and debilitating health conditions and diseases [3].

Micronutrients can be categorized as either Type 1 or Type 2. Type 1 micronutrients are those nutrients that, when not consumed in adequate amounts, result in specific deficiency diseases, and do not always affect growth. Rather, they affect the metabolism and immune competence before signs are apparent. These include deficiency of vitamin A, B1, B2, B3, B6, B12, C, D and folic acid, and minerals such as iron, calcium, copper, iodine, and selenium. In contrast, deficiency of type 2 micronutrients does not show specific clinical signs, but affects metabolic processes and result in growth failure, wasting, increased risk of edema, and lowered immune response that is attributed to the deficiency of specific minerals such as S, K, Na, Mg, Zn, P, and N deficiencies [4,5].

Therefore, this review highlights the magnitude and consequence of the major micronutrient deficiencies, discusses the role of fortification and supplementation in mitigating micronutrient deficiency, and offers some conclusions and recommendations.

Micronutrient Deficiency

Micronutrient deficiency is a serious public health concern throughout the world [6,7]. It is silent epidemics of vitamin and mineral deficiencies affecting people of all genders and ages. Literatures suggest that over 2 billion people are at risk for vitamin A, iodine, and/or iron deficiency globally [8-10]. In the developing world, 20% of the population suffer from iodine deficiency, 25% of children have subclinical vitamin A deficiency, and more than 40% of women are anaemic [11,12], increasing the risk of death, morbidity and susceptibility to infection, blindness, adverse birth outcomes, stunting, decreased cognitive capacity and mental retardation [4,13]. Micronutrient deficiencies are typically due to inadequate food intake, poor dietary quality, poor bioavailability attributed to the presence of inhibitors, mode of preparation, and interactions, and/or the presence of infections [8].

Micronutrient	Estimated impact and efforts to address

Iodine	Associated with brain damage. Easily mitigated with iodized salt While incidence has declined dramatically in recent years due to the universal adoption of salt iodization starting in 1993. WHO estimates that 54 countries still have some iodine deficiency.
Vitamin A	Associated with blindness and increased rich Of disease and death for small children and pregnant women. Can be addressed through supplements, which are now estimated to reach children at least once a year in 40 countries. The UN Standing Committee on Nutrition (UN/SCN) estimates those 140 million children and 7, million pregnant women are VA deficient, primary in Africa and South/Southeast Asia. In 1998. WHO. UNICEF. Canadian International Development Agency, USAID, and the Micronutrient Initiative launched the VA Global Initiative. This provides support to countries in delivering VA supplements.
Iron	Associated with maternal death, impaired physical and cognitive development, increased risk of morbidity in children, and reduced work productivity in adults. Can be addressed through fortification of wheat products. WHO estimates 2 billion people are anemic, and this is frequently exacerbated by infectious diseases. Malaria, HIVI AIDS, hookworm infestation, schistosomiasis, and tuberculosis contribute to a high prevalence of anemia in some areas. Efforts to increase iron intake must be accompanied by efforts to control infectious disease
Zinc	Associated with reduced immune stales in neonates and children. Preliminary research shows that additional zinc can reduce incidence of diarrhea end pneumonia children and improves maternal health. One estimate shows zinc as close to iron deficiency m contribution to the global burden of disease. Can be provided through supplements.
Fiat ate	Deficiency associated with increased risk of maternal death and complications in beth; also associated with neural tube defects in infants and with an estimated 200,000 severe birth defects every year. Can be addressed through fortification wheat products.

Table 1: Micronutrient deficiencies and their estimated impacts [14].

Approaches to Mitigate Micronutrient Deficiency

The widespread recognition of the importance of micronutrient deficiencies in global health, and the potential to address such deficiencies relatively cheaply through fortification or supplementation has led to several multilateral efforts to support traditional interventions [7,14,15]. Supplementation and fortification are intervention strategies that often are aimed at the immediate or short-term amelioration of the situation and often address the symptoms of micronutrient deficiencies [16].

Supplementation

Supplementation refers to the provision of added nutrients in pharmaceutical form (such as capsules, tablets, or syrups) rather than in food where it is most appropriate for targeted populations with a high risk of deficiency or under special circumstances, such as during pregnancy or in an acute food shortage [17,18]. Globally, supplementation with iron tablets is the most widely used strategy for the prevention and control of iron-deficiency or anemia in pregnancy. Pregnant women require nearly three times as much iron as non-pregnant women owing to the physiological demands of pregnancy (expanded red-blood-cell volume, the needs of the fetus and placenta, and blood loss at delivery).

Problem	Presentation	Intervention
Vitamin A deficiency	Striking: blindness, increased child and maternal mortality risk	Easy in children: infrequent high dose capsules
Iodine deficiency	Striking: cretinism, dwarfism, goiter	Easy: iodized salt
Iron deficiency	Subtle: anemia, reduced cognitive development	Difficult: e.g., frequent supplementation
General malnutrition-growth failure	Subtle: smaller children	Difficult: community -based programs
General malnutrition-starvation in emergencies	Striking: emaciated and dying children and adults	Easy (in principle): emergency food aid and other assistance

Table 2: Perceptions and relative priorities of interventions [11].

This high requirement is unattainable by most pregnant women in developing countries and therefore, iron supplementation is recommended during pregnancy on daily or weekly basis [18]. Iron supplementation is also found to effectively treat severe and moderate anemia in pre-school children [19].

Periodic distribution of high-dose vitamin A supplements, either universally to all preschool children or to targeted high-risk groups, is another most widely practiced intervention for the prevention and treatment of vitamin A deficiency throughout the world [18]. Given every 4-6 months, vitamin A is stored in the liver and mobilized, as needed; to meet the demands of target tissues [15,20] averts vitamin A deficiency disorders [21]. Similarly, in cases where iodine deficiency disorders are prevalent, iodized oil capsules are commonly used to fulfill daily iodine requirements of the body if iodized salt is unavailable [22].

Supplementation programmes are used as a short-term intervention measures. It has advantages of rapid coverage of a high-risk population by providing direct a controlled and concentrated dose of the micronutrient to the target group. In addition, supplementation has an immediate impact on micronutrient status and associated functional outcome. Most supplementation programs have been shown to be cost-effective in achieving their nutritional goals and health impacts. However, inadequate coverage (where deficient individuals are missed or reached irregularly), inability to sustain high coverage over long periods of time as financial, political, or other health priorities change, and poor compliance by target individuals (e.g., iron supplementation during pregnancy) hamper the long term goals. As a result, supplementation is mostly replaced with long-term, sustainable food-based measures such as fortification and dietary modification, usually by increasing food diversity [15].

Fortification

Food fortification stands out among public health interventions as one of the most effective methods of preventing nutritional deficiencies where it has contributed significantly to the virtual elimination of goiter, rickets, beriberi and pellagra in the Western world [23]. Fortification refers to the addition of nutrients to foods from which they were either absent or present in small amounts to increase the intake of one or more nutrients. It also includes additions to fulfill the role of another food in the diet [17]. Fortification can be done in three ways. First, by restoring the nutrients lost during food processing to their natural level (for example restoring B-vitamins which are lost during milling). Second, by increasing the level of a nutrient above that normally found in the food (for example adding extra iron to wheat flour or extra calcium to milk). Third, by adding nutrients that are not normally present in a food item otherwise considered a good vehicle for delivering micronutrients to the consumer (for example putting vitamin A into sugar, or iodine into salt) [12,17].

Fortification strategies utilize widely accessible, commonly consumed foods as a vehicle. The most widespread effort to date has been fortification of salt with iodine [23,24]. However, many other foods may be used as vehicles for a variety of micronutrients. Some of the common combinations are wheat products (cereal, bread or pasta) with one or more nutrients including calcium, iron, niacin, riboflavin, thiamine and zinc [25]. Milk can be fortified with vitamin D; fruit and fruit juices have been fortified with calcium and vitamin C. Fish sauce and soy sauce are also recognized as good vehicles [15,24,26].

Successful employment of fortification strategies requires centralized processing facilities, mechanisms for quality control, and social marketing and public education strategies [17]. The required infrastructure is often weak or lacking in developing countries, which reduces the potential for the success of fortification measures [27].

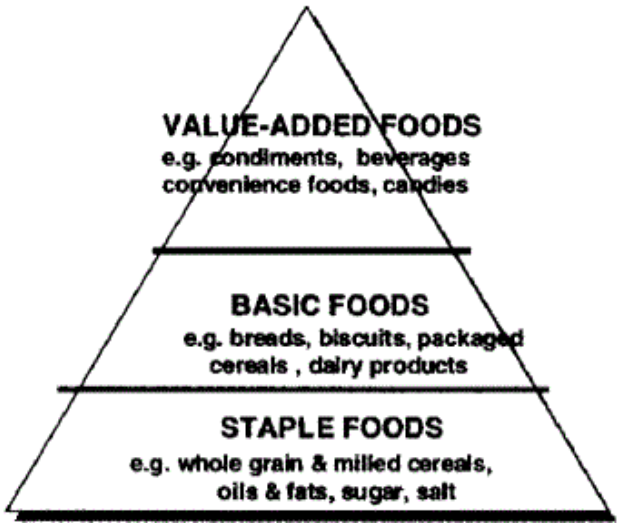

Figure 1: Types micronutrient fortification of food [23].

Adequate income and marketing channels are essential for such strategies to succeed, but the poor and nutritionally vulnerable are frequently less able to purchase fortified food products. Moreover, infrastructures; including roads and transportation systems are weak in many developing countries, where the majority of the populations are at high risk [17,28,29].

Food Vehicle	Fortifying agent
Salt	Iodine. iron
Wheat and corn flours, bread. pasta, rice	Vitamin B complex, iron, folic acid, vitamin B12
Milk, margarine. yoghurts, soft cheeses	Vitamins A and D
Sugar, monosodium glutamate, tea	Vitamin A
Infant formulas, cookies	Iron Vitamins BI and 1:32, niacin. vitamin K. folic acid, zinc
Vegetable mixtures amino acids, proteins	Vitamins and minerals
Soy milk, orange juice	Calcium
Juices and substitute drinks	Vitamin C
Ready-to-eat breakfast cereals	Vitamins and minerals
Diet beverages	Vitamins and minerals
Enteral and parenteral solutions	Vitamins and minerals

Table 3: Widely used fortified foods [9].

Conclusion and Recommendation

Fortification and micronutrient supplementation for the most vulnerable is proven to avert much of the morbidity and mortality associated to micronutrient malnutrition. Micronutrient deficiency often goes unnoticed within the societies which are otherwise healthy. Thus, individuals should be cautious about their daily food intakes. If developing countries like Ethiopia, where the prevalence of malnutrition related mortality accounts for almost half of the total under five age children, large scale micronutrient intervention through

supplementation and fortification can be an option in the fight against malnutrition. However, chronic, high dose consumption of fortified foods and food supplements, often, is associated with over consumption and risk of toxicity. Therefore preliminary nutritional status of the intervention groups should be assessed. In addition, efficacy and safety of nutrients for supplementation should be addressed to avoid the consumption of counterfeited products. The causes of malnutrition are often multifactorial. Lasting fight against micronutrient deficiency requires understanding the dynamics of factors contributing to malnutrition. Thus, further studies regarding the status of micronutrients and the full picture of the effect of fortification and supplementation is recommended.

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