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Nutrition Across the Life Course: A Comprehensive Review of Nutritional Needs and Impacts from Infancy to Old Age

Maria L. Torres, [1*] Ahmed El-Sayed[2], and Emily Zhang [3]

[1] Department of Nutritional Sciences, University of New Cascadia, USA.
[2] Faculty of Public Health, Cairo Global Health Institute, Egypt.
[3] Department of Dietetics, Eastern Biomedical University, China.

***Corresponding author:** **Maria L. Torres**, Department of Nutritional Sciences, University of New Cascadia, USA
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Abstract

Nutrition plays a pivotal role throughout the human lifespan, influencing growth, development, health outcomes, and longevity. This review explores nutritional needs and challenges across distinct life stages: infancy, childhood, adolescence, adulthood, and old age. Drawing upon recent empirical data and global health guidelines, the paper discusses how nutrient requirements evolve and how socioeconomic, cultural, and behavioral factors intersect with dietary patterns. The study emphasizes the importance of early nutritional interventions, the role of public health policy in food access, and the need for age-specific dietary recommendations. The findings support life-course approaches to nutrition that are preventive, adaptable, and culturally sensitive.

Keywords

nutrition, life course, dietary needs, aging, child nutrition, adolescence, public health, nutritional interventions

Introduction

Micronutrients, including essential vitamins and minerals, are critical to numerous biochemical and physiological processes. Unlike macronutrients, micronutrients are needed in minute quantities; however, their absence or deficiency can lead to severe health consequences, particularly in vulnerable populations such as children, pregnant women, and the elderly.

Globally, over two billion people are estimated to suffer from micronutrient deficiencies, often referred to as “hidden hunger.” The most widespread deficiencies include iron, iodine, vitamin A, and zinc. These deficiencies contribute to impaired cognitive development, weakened immune function, increased morbidity, and mortality. The World Health Organization (WHO) has prioritized micronutrient interventions as key strategies in global health improvement.

This paper reviews the physiological importance of key micronutrients, identifies common deficiency patterns, and evaluates public health strategies aimed at addressing micronutrient malnutrition.

Citation: Jane M. Edwards, Rafael L. Monteiro, Anika Sharma (2025), Micronutrients and Their Role in Human Health: A Review of Physiological Importance, Deficiency Patterns, and Public Health Implications. J. Nutrition and Human Health Advances 1(1): dx.doi.org/NHA/PP.0001

Material and Methods

This review utilized a systematic literature search of peer-reviewed articles, governmental reports, and global health databases published between 2000 and 2024. Sources included PubMed, Scopus, WHO publications, and the Global Database on Child Growth and Malnutrition.

Inclusion criteria:

- Studies discussing the physiological roles and deficiency effects of micronutrients
- Epidemiological reports on global and regional micronutrient deficiency prevalence
- Reviews and meta-analyses on dietary interventions, supplementation, and fortification programs

Exclusion criteria:

- Studies with limited human data
- Non-English publications without translation

Data extraction focused on the following variables:

- Nutrient type and function
- Deficiency symptoms and outcomes
- Population groups at risk
- Intervention strategies and efficacy

Results

The review identified five critical micronutrients with substantial global health implications:

1. **Iron**:
Essential for oxygen transport and cognitive development. Iron deficiency anemia remains the most common nutritional disorder globally, especially in women of reproductive age and children.

2. **Vitamin A**:
Key for vision, immune function, and epithelial integrity. Its deficiency can lead to night blindness, increased infection risk, and child mortality.

3. **Iodine**:
Crucial for thyroid hormone synthesis. Deficiency results in goiter, intellectual disabilities, and fetal developmental issues.

4. **Zinc**:
Important for cellular growth, immune response, and wound healing. Deficiency leads to growth retardation and susceptibility to infections.

5. **Folate(VitaminB9)**:

Vital for DNA synthesis and fetal neural tube development. Deficiency during pregnancy increases the risk of birth defects such as spina bifida.

Food fortification and supplementation programs—such as iodized salt, iron-folic acid tablets, and vitamin A drops—have shown varying degrees of success in reducing deficiencies. However, adherence, coverage, and bioavailability remain challenges.

Discussion

Micronutrient deficiencies persist as a major global health concern due to poverty, food insecurity, and lack of dietary diversity. While supplementation and fortification have reduced deficiency rates in some populations, sustainable dietary changes and health education are essential for long-term impact.

Cultural practices, climate, agriculture, and access to healthcare significantly influence micronutrient intake and status. For instance, vegetarian populations may face higher risks of iron and vitamin B12 deficiency due to dietary restrictions.

Biofortification, where crops are genetically enhanced to increase nutrient content (e.g., Golden Rice for vitamin A), represents a promising innovation. However, regulatory, cultural, and ethical considerations must be addressed.

Comprehensive strategies combining education, food policy, healthcare integration, and community involvement are necessary to tackle hidden hunger. National and international coordination among stakeholders is crucial for success.

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Conclusion

Micronutrients, though needed in small amounts, are indispensable for maintaining human health and development. Deficiencies contribute to a range of physical and cognitive impairments, particularly in vulnerable groups. Preventative measures such as dietary diversification, food fortification, and targeted supplementation must be scaled and adapted to regional needs. Continued research, policy commitment, and community engagement are essential to eliminate micronutrient malnutrition and promote health equity worldwide.

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