

Nutrition in the Age of Precision and Systems Biology

Systems approaches are increasingly the norm in the field of nutrition. The field is expanding rapidly from molecular, physiological, clinical, and public health dimensions of nutrient adequacy and diseases of essential nutrient deficiencies to nutrition in chronic disease management and prevention. Volume 43 of the *Annual Review of Nutrition* reflects this expansion, with a strong emphasis on maternal and child nutrition, chronic diseases, and the microbiome.

The molecular antecedents of chronic diseases emerge at the earliest stages of life. O'Brien and Wang explain how “omics” approaches reveal the complex regulation of nutrient flow to the developing embryo and how that regulatory control impacts life-long health for mammalian offspring. Maternal nutrition, while critical for healthy fetal growth, also plays a key role in programming embryonic and fetal physiological networks. Campoy and colleagues summarize current knowledge of maternal and infant nutrition on the microbiota–gut–brain axis, and Nemeth and colleagues cover the complex regulatory pathways and associated mechanisms that determine iron homeostasis during pregnancy. Robertson and colleagues discuss the microbiome in states of childhood undernutrition, and its cascading effects on child metabolism, immunity, and numerous other physiological systems, and provide an inventory of novel approaches for potential microbiome therapies.

Once established, chronic disease and associated inflammatory states can alter nutrient needs relative to healthy individuals. Spooner and Jump review evidence for the use of ω 3 polyunsaturated fatty acids in nonalcoholic fatty liver disease for people with obesity and type 2 diabetes. Metabolic diseases alter glucose homeostasis, and Shah and Wondisford review how variations in gluconeogenic flux contribute to different disease states, as well as strategies for targeted treatment. McNulty and colleagues review emerging evidence for widespread subclinical riboflavin deficiency, even in some high-income countries, which has gone unrecognized because of a lack of population studies. Low riboflavin status throughout life, leading to anemia and hypertension, may make significant contributions to the global burden of disease.

Many individuals meet their nutrient requirements through dietary supplements. Bailey et al. reveal major gaps in population surveillance studies aimed at understanding the use of these supplements. Methods to evaluate supplement intake vary considerably, highlighting the need for harmonization to accurately assess the prevalence and intake levels and their connection to health and disease outcomes.

The concept of nutrition security is fundamental to establishing policies and programs aimed at reducing chronic disease outcomes, and Seligman et al. propose a framework

for assessing and monitoring nutrition security across populations. The challenge of developing population-based guidance for food and nutrient intakes based on chronic disease end points, where there is heterogeneity in the diet-disease relationship, is presented by Bailey and Stover. Artificial intelligence (AI) approaches are now being used to better address the complexity of diet-disease relationships. Elinav and colleagues provide a set of case studies illustrating how AI and related technology can be used to help understand physiological network behavior and suggest nutrition-based interventions to prevent and/or manage chronic diseases.

These are still many gaps in our understanding of the fundamental biochemistry and physiology of nutrition and metabolism in health and disease. In this volume, recent advances in serine metabolism (Handzlik and Metallo), bone-derived osteocalcin (Karsenty), amino acid transport (Bröer), and fatty acid binding proteins (Storch and Corsico) are highlighted.

The autobiographical chapter spotlights the distinguished career of Professor James Ntambi, a role model and inspiration for his consistent excellence in research, teaching, and mentorship.

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