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Nutrition Research of the Human Microbiome Project

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Introduction

Proper eating is one of the most effective and economical ways to reduce the risk of many diseases and the risk factors that go along with them, such as obesity. To better understand the causes of obesity and related disorders, nutritional research is essential. As a result, it has the potential to have a significant influence on both the economy and global health. The following crucial areas are the focus of ASN's nutritional research needs: (a) individual variation in dietary and food responses; (b) healthy development, maturation, and fertility; (c) health care; (d) medical treatment; (e) dietary habits; and (f) dietary supply/environment. To preserve excellent health and functional capacity, nutrition is also crucial. The basis of a healthy populace and a robust economy is basic research on the connection between nutrition and non-communicable illnesses, nutritional composition, and dietary monitoring. The results of these nutritional research requirements will help to clarify approaches to the avoidance and management of both infectious and non-communicable illnesses, such as cancer, diabetes, and cardiovascular disease. The outcomes of these nutritional research needs will explain strategies for the prevention and treatment of infectious and non-communicable diseases like cancer, diabetes, and cardiovascular disease. We must define the variables that affect the spread and growth of our microbiota and microbial partners to comprehend the biological and genetic diversity of humans. Microbiology enters a new age with the use of DNA sequencers and mass spectrometers, shifting its emphasis from the features of isolated organism types to the operation of whole communities. The rapidly developing subject of metagenomics examines these communities' genome-anchored traits [1].

Ecology and Scale-Related Issues

With the aid of genetic sequencers and analytical spectrometers, microbiology enters a new era, focusing less on the characteristics of lone organisms and more on the functioning of whole communities. Metagenomics, a rapidly emerging field, investigates the genome-anchored characteristics of these societies [2]. The top six nutritional research requirements include everything from basic science to health policy and from findings to implementation—the whole research spectrum. One of the main objectives of future nutrition research is to have a better understanding of the variance in nutritional and physiological properties of food. The development of tailored nutritional therapies and greater knowledge of health and food policy will be aided by studies that demonstrate this variability, including potential suggestions for known biologically active ingredients and recommended dietary intakes for nutritional requirements. Omics contributes to the creation of novel illnesses and nutritional indicators, as well as the assessment and reflection of an individual's nutritional state. Information on a person's specific dietary requirements, covering digestion, absorption, metabolism, and how nutrients function in the body, is available via omics. We must compare limited data that was acquired from a small sample of people to describe our microbiome due to several restrictions. The notion of island biogeography [3], established from macroecosystem research, can be helpful for interpreting the observed microbial diversity if ecosystems of the human body, such as the gut, are seen as an archipelago in space and time.

Human Microbiome

More than 90% of all bacterial phylogenetic types (phylotypes) are found in just two of the 70 known divisions (phyla) within the bacterial domain: Bacteroidetes and Firmicutes. This finding is supported by the decreasing costs and speed of DNA sequencing as well as improvements in computational methods for analyzing complex datasets [4–7]. Individual variations within the colon were larger than those across other colon sample sites. Also, feces illustrate how humans differ from one another. The 16S rRNA-based findings on human gut microbiota diversity may be consistent with predictions based on neutral community assembly theory that most species share the same general or largest niche and thus are likely to be functionally redundant [8]. A statistically significant enrichment of genes involved in (i) glycan, amino acid, and xenobiotic metabolism, (ii) methanogenesis, and (iii) 2-methyl-D-erythritol-4-phosphate pathway-mediated vitamin and isoprenoid biosynthesis was found in the human genome, metabolic reconstructions of their intestinal (faecal) microbiomes [1]. Nutrition has a critical role in avoiding reproductive illnesses, including prostate and ovarian cancer, and has a direct impact on fertility and the capacity of both mother and father to conceive. Weight control and the treatment of infectious disorders are included in health care. Research is needed to make sure that recommendations for nutrition throughout life correspond to real biological demands. The avoidance of disease-related processes like inflammation and the identification of systems crucial to preserving health, such as immunological competence, are among the research fields. The prerequisites for both humans and animals' optimal health have been studied using animal models. Caregiving for preterm newborns now provides a new issue in early nutrition management

due to advancements in medical technology, as evidenced in IVF and neonatal care. Premature infants have unique dietary requirements that have a significant effect on their eventual growth and development as well as their possible adult health status [9–12]. To determine and monitor human health and outcomes for subgroups, such as ethnic and racial minorities, studies using biomarkers of consumption and exposure are necessary to ascertain and monitor meal regularity and size, rate of food intake, and how social cues affect these factors. Biomarkers responsive to diet and nutrition can help assess disease progression and variability in response to treatment and improve early diagnosis and prevention. As food supplies change rapidly, biomarkers for accurate monitoring of food and nutrient intake need to be further developed and validated.

The Concept of a Core Human Microbiome

The core (orange) is viewed as a set of shared genes found in a given habitat (e.g., gut, mouth, and skin) in all humans. The core is surrounded by a set of variably represented genes (blue): this variation could be influenced by a combination of factors (arrows), including transient populations of microbes that are not able to persistently colonize (allochthonous organisms), lifestyle (including diet), various environmental exposures (place of residency or work), host genotype, host physiologic status, including the properties of the innate and adaptive immune systems, and disease (Figure 1). The hazy line surrounding the core indicates the possibility that over the course of human 'micro-evolution', new genes may be added to the core microbiome while others may be lost [13].

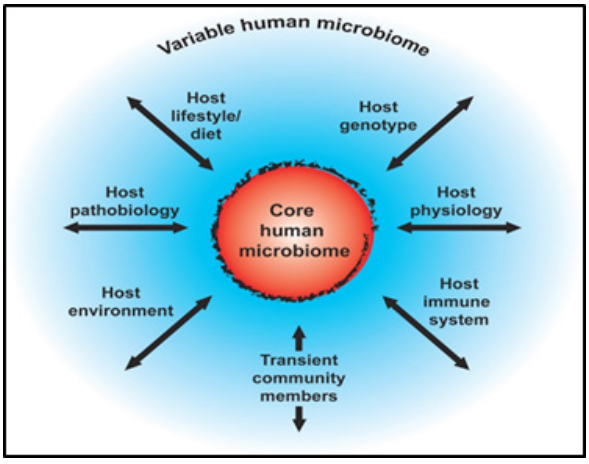

Figure 1: Concept of a core human microbiome [13].

Conclusion

One of the most efficient and economical strategies to prevent chronic and non-communicable illnesses and associated risk factors, such as obesity, is via a proper diet. The variety in people's reactions to food is the largest barrier to advancing the link between food and health; it is also the root of public skepticism about the acceptance of nutritional guidance and its business potential in the private sector. We will be able to determine which groups of individuals are most likely to profit from prescriptive dietary guidance using a range of technologies and will then be able to provide these groups of people with specialized nutritional recommendations based on their metabolic risk profiles [14,15]. Understanding our microbial ecology will help us better understand human nutritional demands and develop workable solutions to deal with changes in agricultural methods and the food supply that will be triggered by global warming and economic expansion.

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