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EDITORIAL

The interaction between the microbiome, diet and health

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The gut microbiome refers to the intestinal community of microbes that help to maintain and influence health. This community includes trillions of microbes from more than a thousand bacterial species.[1,2] As a supraorganism vital to human well-being and survival, the microbiome has developed alongside humans.[1] According to Velasquez-Manoff,[2] "our intestinal community of microbes calibrates our immune and metabolic function, and its corruption or depletion can increase the risk of chronic diseases."

The gut microbiome is separated from the host by a single layer of epithelial tissue, which provides both a physical and chemical barrier.[3–5] The microbes in the gastrointestinal (GI) system react rapidly to various factors in their environment, with beneficial environments resulting in good diversity and less beneficial environments leading to lower diversity and dysbiosis.[6,7] Dysbiosis is defined as the overgrowth of a pathogenic microbiome leading to decreased GI barrier function and dysregulation of the immune system.[8] Although functionally related microbes can compensate for the function of other missing species, certain conditions, such as obesity, non-communicable diseases and other inflammatory diseases, including inflammatory skin disease, arthritis, inflammatory bowel diseases and irritable bowel syndrome (IBS) are closely associated with low microbial diversity and dysbiosis.[9–11]

The current definition of the term "probiotic", adopted by the Food and Agriculture Organization of the United Nations and the World Health Organization in 2002, states that these are "live strains of strictly selected microorganisms which, when administered in adequate amounts, confer a health benefit on the host." On the other hand, prebiotics are non-digestible dietary substances that serve as a food supply for probiotics, promoting their growth and altering their composition or activity in a favourable way. When probiotics and prebiotics are combined, their ability to impact on the microbiome is enhanced, and Gibson and Roberfroid coined the word "synbiotic" to characterise a blend of probiotics and prebiotics that work synergistically.[12]

In this issue of the journal, Stevenson et al. investigated the effect of the single strain probiotic *Lactobacillus plantarum* on gut microbiota and IBS symptoms. In addition, they determined correlations between dietary intake and gut microbiota. Although there was no significant difference in bacterial counts or symptom severity scores between the experimental and placebo groups, there were significant direct correlations between fibre and *Lactobacillus plantarum* and inverse correlations between fibre and *Bacteroides* spp., suggesting that nutrients can have a significant impact on gastrointestinal microbial profiles. The authors acknowledge that they only investigated a few key groups of bacteria in the faeces of a relatively small sample of participants, and that there could have been quantitative shifts between factions within groups that were undetected in their analysis. Despite these limitations, the study confirmed that *Lactobacillus plantarum* differs between IBS phenotypes and confirmed important correlations between certain nutrients, especially fibre, with certain bacterial profiles that may have implications for the management of IBS.

A large body of evidence verifies that dietary patterns and certain nutrients strongly correlate to specific bacterial profiles and metabolomic responses.[9,10] In a healthy person, the gut microbiome composition is largely stable, although microbial dynamics are significantly impacted by host lifestyle and diet.[9,10] The beneficial species *Bifidobacteria* and *Firmicutes* are generally abundant in the microbiome of people from non-westernised communities, whereas less favourable *Bacteroides* are more abundant in the microbiome of people from westernised communities.[13]

The GI microbiota metabolises low fat, high fibre diets into products that are thought to be protective against the development of western diseases.[14] Dietary fibre is a good source of microbiota accessible carbohydrates (MACs) that are used by microbes to provide the host with energy and a carbon source.[15] The microbial fermentation of fibre and resistant starch, leads to the production of the short-chain fatty acids (SCFA), acetate, butyrate and propionate. SCFA lower the colonic pH, encouraging the growth of beneficial bacteria such as *Lactobacilli* and *Bifidobacterium* while reducing the growth of harmful bacteria, assisting in maintaining a healthy immune system.[16–19] The SCFA butyrate is the primary energy source for epithelial tissue in the gastrointestinal tract and contributes greatly to gut integrity.[10,14,20] High fibre diets result in abundant butyrate production, exceeding the butyrate consumption capacity of colonocytes.[14] The remaining butyrate enters the systemic circulation, exerting epigenetic and immunomodulatory effects on organs that may partly account for the reduced mortality rates from obesity and non-communicable diseases observed in individuals consuming high fibre diets.[14]

Diets that are high in animal protein and low in carbohydrate increase *Bacteroides* and reduce the abundance of beneficial *Bifidobacterium*, limiting the production of SCFAs and butyrate-producing bacteria and degrading the colonic mucus barrier.[9,10] On the other hand, plant protein increases the abundance of *Bifidobacterium* and *Lactobacilli* and reduces *Bacteroides* and *Clostridium perfringens*, resulting in improved gut barrier function and reduced inflammation.[14] Furthermore, recent research has found that diets high in saturated fat are also associated with microbial changes that induce inflammation, characterised by increased *Bacteroides* and anaerobic microflora.[9,10] In contrast, low-fat diets increase the abundance of *Bifidobacterium*, resulting in reductions in fasting glucose levels and total cholesterol.[10]

Prebiotics, probiotics and traditionally fermented foods are being investigated as mechanisms for modulating the GI microbiota and the treatment of disease conditions ranging from targeted therapies for childhood malnutrition to obesity, cancer and inflammatory diseases.[9,14] The inextricable effect of the microbiome on human health and homeostasis is becoming more and more apparent, necessitating the development of individually tailored nutritional interventions targeting the microbiome and its function.[9,10,14]

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