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Terry L. Wahls
Dept. of Veteran Affairs; University of Iowa, Iowa City, IA, USA, terry.wahls@va.gov

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Feeding Your Microbiome Well

Terry L. Wahls, M.D.

Terry Wahls, M.D.,
Clinical Professor of Medicine
Division of General Medicine
Carver College of Medicine
University of Iowa

Director, Extended Care and Rehab Service line
Iowa City VA Health Care System
2e05
601 West Highway 6
Iowa City, IA 52246
Phone: (319) 338-0581 ext. 6080
Fax: (319) 339 -7048
Email: Terry.Wahls@va.gov

Corresponding author: Terry Wahls, M.D.

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There is increased recognition that the health of the individual depends on the health of the ecosystem of the microbial community living on and in the body of the individual. The state of the individual's ecosystem is reflected in the diversity of species living in the gut microbiome. This paper will summarize recent findings on the gut brain axis, the connection between the gut microbiome and health status, and practical steps an individual can take to monitor and improve the diversity of species in their gut microbiome.

Life began approximately 4 billion years ago in the ocean, initially as single cell organisms. One and a half billion years ago, the development of mitochondria allowed for the evolution of multicellular organisms. As early animals developed a digestive tract, single cell organisms from those ancient seas entered the gut and co-evolved with early animals. Animals have since developed a cooperative mutualistic relationship with the microbes in their gut; these microbes assist the individual with completing the metabolic processes required for life.

There is increasing recognition that gut microbes have a complex relationship with the brain, the immune cells, and the health of the host. Gut microbes and their metabolic byproducts influence the levels of systemic and central nervous system inflammation. In addition, microbes impact neural pathways and endocrine system via the hypothalamic pituitary adrenal axis[1-3]. Microbes in the gastrointestinal tract are under selective pressure to manipulate the host's eating behavior in order to increase their population by generating cravings for their preferred foods and suppressing competitors. These manipulations may occur at the expense of the host[4].

In animal models the microbiome impacts the activity of genes that regulate myelination[5], and there is evidence linking the growth of the brain to the nutritional status and the microbiome of the individual. In two studies of humans with multiple sclerosis, patients with multiple sclerosis had a microbiome distinct from control subjects[6-8]. Likewise, in a study of rheumatoid arthritis patients, analysis of the microbiome found that the gut and oral microbiome was distinct between controls and patients with rheumatoid arthritis[9].

Cross-sectional analyses of hunter-gatherer societies, primitive subsistence farmers, and westernized urbanites have shown each group has a distinct gut microbiome. The greatest microbial diversity is observed in hunter-gather societies and the smallest diversity in westernized urbanites[10]. There is increased recognition that the species that once resided in the human gut microbiome are diminishing and at risk of becoming extinct. Researchers are beginning to ask what the health consequence of the lost biodiversity in the gut microbiome is[11].

Microbes that are considered pathogens in westernized urbanite dwellers have been consistently observed in hunter-gatherer societies without causing disease[10]. This suggests that our concept of pathogen should be adjusted to consider context, including other organisms in the community, which may influence whether a particular species is disease-promoting.

Over the last 500 million years of the mammalian species, the microbiome has been passed to the next generation as offspring pass through the birth canal during the birthing process. Each individual establishes a mix of microbial species in their gut microbiome that is unique and can be used as an identification tool. The metabolic functions provided by the microbiome help individuals conduct the chemistry of life, and these metabolic functions may be fulfilled by different microbial species[12]. The greater the diversity in the species that support the various metabolic functions, the more stable the microbiome is and the more resistant it is to external perturbations[13]. The diet can change the mix of microbial species very quickly, providing substrates that give competitive advantages to different microbial populations. Within just three days of shifting from an animal protein–based diet to a plant-based diet without animal proteins significant shifts in gut microbiomes can be observed[14].

Since the industrial revolution there has been a dramatic change in the dietary habits of westernized societies. In 2000, over 153 pounds of sugar was consumed per person per year, with a concomitant increase in the incidence of obesity[15]. Over that same period, the intake of vegetables has declined to less than 1.5 servings per person per day.

There are multiple strategies to improve the diversity of the gut microbiome, including the following.

1) Have a vaginal delivery. If a Caesarian section is needed, swab the child with mother's vaginal secretions immediately after birth.
2) Breastfeed for 2 to 3 years. Breast milk contains human milk oligosaccharides, which the baby cannot digest but the bifidobacteria can, helping to establish the baby's gut microbiome. A side benefit of breastfeeding is the favorable development of the upper and lower jaws, markedly improving the alignment of teeth and markedly reducing the risk of malocclusion and the need for orthodontia.
3) Consider the use of probiotics if born via Caesarian section or antibiotics are given early in life. Saccharomyces Boulardii is the most studied yeast probiotic and Lactobacillus Rhamnosus is the most studied bacterial probiotic[16]. However, once you stop the probiotic, it does not continue to live in the gut microbiome.
4) Eat fermented foods. All probiotic strains are derived from fermented foods. Gradually add live culture fermented foods such as kimchi, sauerkraut, or kombucha to increase the diversity of the gut microbiome.
5) Fertilize the gut garden by eating more microbial-accessible carbohydrates, replacing sugar and processed foods with non-starchy vegetables.

Microbiota-accessible carbohydrates (MACs) – what we refer to traditionally as fiber -- resist digestion by the human gut but can be consumed by the gut microbiota[17]. The hunter-gatherer diets averaged 100 to 150 grams of fiber per day[18]. The current recommendation is 36 grams of fiber per day; modern urbanites eat an average of 15 grams of fiber per day. The consequence of consuming a diet low in microbiota-accessible carbohydrates is decreased diversity of the microbial species, altered function of the gut barrier, and increased levels of inflammatory cytokines.

I am the medical director of a Therapeutic Lifestyle Clinic where we teach our patients how to use dietary approaches to reduce symptoms related to chronic medical and mental health problems. We recommend a low or no grain diet that emphasizes non-starchy vegetables and berries and sufficient protein. The following are the specific dietary recommendations we use in our clinic: gradually increase MACs by replacing sugar, processed foods, and grain-based foods with vegetables; consume 6 to 9 cups (measured raw) of vegetables per day; and improve the quality of the food consumed according to financial resources. The clean fifteen and dirty dozen consumer guides from the Environmental Working Group are recommended tools to prioritize how the food budget is allocated.

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Chronic constipation is associated with higher rates of cancer, metabolic dysfunction, and oxidative stress[19]. In our lifestyle clinics we advise patients that reducing constipation will likely reduce the risk of many chronic health problems and improve multiple markers that are associated with better health status. We also encourage our patients to monitor the health of their gut microbiome by monitoring the quality and quantity of stool passed. How many bowel movements occur within 24 hours? Is the bowel movement(s) hard individual lumps? Is the bowel movement(s) smooth and soft, like a long snake? Is the bowel movement(s) pudding-like, mushy, or liquid, indicating excess inflammation? We advise our patients that the optimal pattern is to have soft, easily passed stool. If the stool is hard, the amount of MACs consumed is to be increased or decreased as needed to achieve one or two soft stools each day. If chronic diarrhea is occurring, suggesting excess inflammation, additional evaluation is recommended.

In summary, a healthy ecosystem is required to achieve optimal health for the individual. The gut microbiome diversity is a reflection of the health of the ecosystem and the individual. Increased diversity in the gut microbiome is associated with higher intake of fiber and resistant starch. Replacing dietary sugar and processed foods with vegetables and limited fruits will provide more microbial-accessible carbohydrates and is associated with higher levels of diversity in the gut microbiome.

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