Go with Your Gut: the Role of Gut Microbiota in Health

February 2020 FN/Nutrition/ 2020-01pr

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What Does Gut Microbiota Mean?

Living within your gastrointestinal tract (gut) are about 100 trillion bacterial cells—your gastrointestinal microbiota—a host of bacteria that play a vital role in your body (Ghaisas, Maher, & Kanthasamy, 2016). Your gut microbiome is responsible for a wide variety of functions that contribute to overall health and may be linked to many chronic diseases including cancer, obesity, and cardiovascular disease (Ghaisas et al., 2016; Peregrin, 2013).

This fact sheet will discuss the role the gut microbiome plays in various aspects of health and how to improve your gut health.

Microbiota is a plural term that includes all the different bacterial species on or within the human body (Valdes, Walter, Segal, & Spector, 2018).

Microbiome is a collective term for all the combined genetic material of bacteria living within the body. It is also used to describe the bacteria as an organ system (Valdes et al., 2018).

Gut health is a term that is used to discuss the many ways that our gut interacts with the rest of our body and health. It includes effective digestion and absorption, absence of gastrointestinal illnesses and diseases, a stable and diverse gut microbiome, and an effective immune system (Bischoff, 2011).

The Unique Gut Microbiome

Everyone has a unique gut microbiome that reflects a host of factors and that can change throughout the lifespan. The microbiome is impacted by genetics, exposure to different bacteria, environmental conditions, immune function, and dietary habits (Ghaisas et al., 2016). The presence of pets or other animals can also influence gut microbiota (Ghaisas et al., 2016). Although there are many ways to increase microbiota diversity, there are also factors that can impede the growth of healthy gut bacteria. Medications, particularly antibiotics, can hinder bacterial diversity and lead to long-term deficits in the gut microbiome (Valdes et al., 2018). Decreased microbial diversity is under scrutiny as gut microbiota have a wide variety of roles and impacts on health, as explained below in Table 1.

Early Microbiome Development

Development of a microbiome begins during birth and continues throughout life (Mueller, Bakacs, Combellick, Grigoryan, & Dominguez-Bello, 2015; Wu et al., 2011). Some research suggests that vaginally delivered babies are exposed to more bacteria than babies delivered by cesarean section and as a result may have a more diverse gut microbiome (Ghaisas et al., 2016; Wu et al., 2011). However, the practice of swabbing or wiping babies with bacteria from their mother in an effort to replicate vaginal birth has sparked some controversy amongst practitioners and could be potentially detrimental to infant health (Reardon, 2019). Ongoing research is underway to find more conclusive data concerning the impact of mode of birth on gut microbiomes (Reardon, 2019).

Another potential area of influence on gut microbiome development is the mode of early infant feeding. Some research indicates that breastmilk transmits beneficial bacteria from the mother to her baby through direct breastfeeding and skin-to-skin contact (Dunn et al., 2017). Certain components of breastmilk, called milk oligosaccharides, may promote healthy bacterial growth and diversity and may increase infant immunity (Ghaisas et al., 2016; Mueller et al., 2015).

Table 1. Roles and Impacts of Gut Microbiota.

Role	Impact
Digestion and fermentation	Gut bacteria can break down and ferment dietary fibers called oligosaccharides that are non-digestible by humans. These are fibers found in fruits, vegetables, nuts, and whole grains.
Energy production	Some bacteria produce short-chain fatty acids, small fat molecules which are used to fuel cells in the colon and the liver.
Vitamin synthesis	Gut bacteria synthesize vitamin B, B12, and K.
Immune system	Colonies of commensal bacteria can prevent harmful bacteria from colonizing the gut and secrete antimicrobial substances. The gut microbiome acts as a barrier and first line of defense for the rest of the body.
Fewer symptoms of gut distress	The presences of certain gut bacteria may relieve diarrhea and constipation, as well as symptoms of irritable bowel syndrome
Neurotransmitter and other signaling molecule production	The gut microbiome produces many neurotransmitters and hormone signaling molecules which allows the gut to interact with other parts of the body, such as the brain. This may have an impact on gastrointestinal, neurological, and psychological disorders.

Martin, Osadchiy, Kalani, & Mayer, 2018; National Center for Complementary and Integrative Health [NCCIH]; Peregrin, 2013; Valdes et al., 2018

The Gut Brain Axis

The gut-brain axis is a term applied to the two-way communication system between the central nervous system and the digestive tract. These are connected through a network of neurons called the vagus nerve, as well as through endocrine (hormone) and immune signaling mechanisms (Foster, Rinaman, & Cryan, 2017; Martin et al., 2018). Some studies have shown that changes in gut bacteria composition can indirectly impact brain chemistry. This is accomplished through the production or the disturbance of various signaling molecules, influencing our response to stress and increasing the prevalence of disorders such as anxiety and depression (Bruce-Keller, Salbaum, & Berthoud, 2018; Foster et al., 2017). It also has a potential role in the treatment of gastrointestinal disorders such as irritable bowel syndrome as well as neurological disorders (Martin et al., 2018). However, more research is needed, especially human clinical studies, as the exact mechanisms of how signaling molecules originating in the gut, communicate with the central nervous system and the brain are poorly understood (Martin et al., 2018).

Gut Bacteria, Chronic Disease, and Obesity

Emerging reviews of research indicates that gut bacteria composition may greatly influence the development of chronic diseases (Valdes et al., 2018). This includes cancer, obesity, cardiovascular disease, irritable bowel syndrome, Crohn's disease, ulcerative colitis, neurological disorders, Parkinson's disease, and type two diabetes, among others (Bruce-Keller et al., 2017; Ghaisas et al., 2016; Peregrin, 2013). One of the main targets of research is the connection between the gut microbiota and obesity. Some research suggests that people who are overweight may have a lower diversity of gut bacteria (Valdes et al., 2018). However, other studies have failed to find this association. For instance, authors of one well known study observed no association between BMI and gut microbiota composition and diversity (Finucane, Sharpton, Laurent, & Pollard, 2014). Lack of diversity may lead to metabolic complications as well as altered regulation of hormones and energy, contributing to long-term weight gain (Valdes et al., 2018). Ongoing research indicates that improving diversity in the gut through diet and fecal transplants in people with obesity could potentially improve metabolic markers and weight loss (Valdes et al., 2018). However, human fecal transplant studies to decrease obesity have been largely disappointing. In two separate studies, obese subjects were given fecal transplants from lean donors but did not lose weight; however, glucose metabolism was improved (Kootte et al., 2017; Vrieze et al., 2012).

Gut Bacteria and Diet

There are many different types of bacteria living in the gut, and each has a unique function. Common types include *Bacteroides*, *Firmicutes*, and *Prevotella*; however, research concerning which types are more beneficial for humans is nonconclusive. The bacterial colonies in the gut are highly susceptible to change, and can change in a matter of hours or days (David et al., 2014). Many studies advocate that the best way to improve gut microbiome diversity and health is to eat a diet rich in prebiotics, probiotics, and fiber—meaning plenty of fruits, vegetables, nuts, and whole grains (David et al., 2014; Peregrin, 2013). Table 2 lists examples of probiotics and prebiotic foods that can be included in the diet.

Probiotics and Prebiotics

Probiotics and prebiotics promote a healthier gut by increasing the population and diversity of good bacteria. They may help to lower inflammation in the gut, as well as stimulate the gut's natural immune system (Ghaisas et al., 2016; Valdes et al., 2018). One drawback of a diet high in prebiotics is that the high fiber content may lead to some side effects such as gas and bloating.

Probiotics are live, beneficial microorganisms found in some foods. Probiotics may have health benefits which help our bodies function properly.

Prebiotics are any natural food components that pass through the gastrointestinal tract that are not digested or broken down for use by human gut cells but can promote the growth or activity of the beneficial bacteria living in the gut (Ghaisas et al., 2016; NCCHI, 2014, Wolfram, 2018).

Table 2. Probiotic and Prebiotic Food Sources.

Probiotics	Prebiotics
• **Yogurt- check for probiotic content** • **Sauerkraut** • **Miso** • **Kefir** • **Kimchi** • **Kombucha** • **Yeast** • **Tempeh**	• Fruits such as bananas and apples • Vegetables such as leeks, asparagus, and broccoli • Onions • Garlic • Nuts such as walnuts or almonds • Soybeans • Whole wheat foods • Oats • Flax seeds • Foods supplemented with prebiotics

(Peregrin, 2013; Wolfram, 2018)

Probiotic supplements are now widely available to consumers, but not all supplements are created equal. Most probiotic supplements in the United Stated are sold as 'dietary supplements' and do not need approval by the Food and Drug Administration before being marketed and sold (NCCIH, 2011). Always consult your healthcare provider before taking probiotics, especially if you have other health concerns (NCCIH, 2011; Wolfram, 2018).

Summary

Increasing diversity and maintaining the balance of your gut microbiota can have long-lasting health impacts. While some factors, such as mode of birth and genetics cannot be changed, other factors can be altered in order to improve gut health, particularly diet. A diet rich in probiotic and prebiotic foods can improve the number of good bacteria residing in the gut. Having a healthy gut will also improve digestion and absorption of nutrients, boost the immune system, and can help protect against chronic diseases.

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