

The Human Microbiome in MCH – Frequently Asked Questions

Q: What is the human microbiome?

A: The human microbiome is the collective genetic representation of microbial communities found on several different sites on and inside the human body including the nasal passage, oral cavities, skin, urogenital tract and the GI tract. The term *microbiota* refers specifically to the community of microorganisms whereas the term *microbiome* refers to the genetic information of these microorganisms.

Q: What is the Human Microbiome Project?

A: Launched in 2007 by the National Institutes of Health, the Human Microbiome Project is an effort to characterize the microbial communities on the human body in order to understand their role in human health and disease.

Q: What is the role of gut microbiota?

A: Intestinal microbiota aid in the metabolizing of our food, produce vitamins such as vitamin K, biotin and folate, help develop our immune system, create a barrier in our intestines to prevent infection, suppress pathogenic microbial growth by secreting antimicrobial substances, metabolize dietary carcinogens, modulate brain gut axis during neuronal development and modify the production of neurotransmitters such as serotonin.

Q: How is the gut microbiota developed and how does it change throughout an individual's lifespan?

A: Throughout the lifespan, an individual's gut microbiota composition will shift due to a variety of factors. Because the bacteria in our intestines rely on the food we eat in order to produce energy to maintain themselves, diet from infancy through adulthood into older age has the largest impact on gut microbiota composition. Starting at birth the gut is initially colonized through microbial transfer from the mother's intestinal and vaginal sites and from the outer environment within a few hours from birth. Vaginally delivered infants have a greater diversity of gut microbiota compared to cesarean delivered infants. Premature infants also have less developed intestines and also show differing gut microbiota composition compared to infants born at term; this has been linked to the increased likelihood of premature infants developing necrotizing enterocolitis. Breastfeeding also plays a role in the development of the infant gut; the indigestible carbohydrates present in human breast milk that are a food source for the infant's beneficial intestinal bacteria. Antibiotic use, hygiene status and functional nutrients also shape the development of the infant gut. The infant gut microbiota composition develops from birth through about 2 years of age, after which the infant gut composition more closely resembles that of the adult gut. During early childhood, the gut continues to evolve in response to shifts in diet, illness and antibiotic therapy and malnutrition. The adult gut microbiota is relatively stable, changing at a slower rate than the infant and child, however changes to diet, probiotic use, antibiotic therapy, medications, stress, hygiene and sanitation, living environment and age can all impact adult gut microbiota composition.

Q: What health outcomes are associated with disturbances in gut microbiota?

A: There is growing evidence that our gut microbiota are related to health outcomes. We can see our relationship with our gut bacteria as mutually beneficial – by providing our gut bacteria with the foods they need to create a healthy balance of beneficial microorganisms, or *eubiosis*, we benefit from all of their functional properties. *Dysbiosis*, or an imbalance in gut microbiota, is linked to malnutrition, irritable bowel syndrome, irritable bowel disease, celiac disease, obesity, cardiovascular disease, metabolic syndrome, type-2 diabetes, non-alcoholic fatty liver disease, atopy, cystic fibrosis, cancer and autism. There are suggested links between gut health and stress as well. Overgrowth of key microorganisms can also cause disease states such as necrotizing enterocolitis in infants and *C. difficile* colitis.

Q: How can diet support the development and maintenance of diverse gut bacteria and overall good gut health?

A: Infants who are breastfed have increased gut diversity compared to infants who are formula fed. Diets high in indigestible carbohydrates, or prebiotics (i.e., diets that are generally plant-based and higher in fiber), increase gut diversity and the presence of more beneficial bacteria. Studies show that probiotics can be beneficial to gut health. Probiotic rich foods include cultured dairy and unpasteurized fermented foods such as kimchi and sauerkraut. When it comes to probiotic supplements, it is important to remember that these products are not regulated, so care should be taken when selecting probiotic supplements. Products with live and active cultures are likely more beneficial than those without.

Q: What is a fecal transplant?

A: A fecal transplant, also known as fecal microbiota transplantation (FMT), is the process of transplantation of fecal bacteria from one organism to another. Fecal transplants are commonly used in animal studies exploring the role of the gut microbiota in health outcomes and behavior. In humans, the infusion of feces from healthy donors to donors that are suffering from recurrent *Clostridium . difficile* infection has proven to be more successful than antibiotic therapy. FMT has also been used to treat other conditions such as colitis, constipation, IBS, and some neurological conditions such as multiple sclerosis and Parkinson's disease. Currently, FMT is regulated by the Food and Drug Administration as an experimental drug.

Q: How long does it take for the gut microbiota composition to shift in response to dietary changes?

A: About 2-3 days, although lasting change to the gut microbiota would need to be supported through maintaining the dietary change.

Q: As a generally healthy individual, what is better for me and my gut health - taking probiotic supplements or eating fermented foods?

A: Probiotic supplements are not regulated, so care should be taken if selecting this option for supporting gut health. It is important to remember that supplementation alone with probiotics may benefit short-term gut health, but long-term growth of beneficial bacterial strains supplied through probiotics will require continued consumption of prebiotics as well. Inoculation of beneficial bacterial strains through fermented and live foods is recommended because you are providing both the bacteria and their bacterial food source – a combination of pre- and probiotics – in addition to the beneficial metabolites that have been produced by the bacteria fermenting the food source.

Q: Where can I stay up to date with the latest information on gut microbiota research as it relates to diet and health

A: There are several websites and resources on gut microbiota as it relates to health and diet, including:

- Gut Microbiota for Health: <http://gutmicrobiotaforhealth.com/>
- The Human Microbiome Project publications: <http://hmpdacc.org/pubs/publications.php>
- NPR stories about the Microbiome: <http://www.npr.org/tags/172709084/microbiome>

Q: How can I analyze the composition of my own gut microbiota?

A: The American Gut Project, run by a team of scientists at the University of Colorado-Boulder, provides sample kits for analyzing the microbiome from various sites of your body, including your gut. By participating in the American Gut Project, you are helping scientists understand the variation of microbiomes across the American population. You can even send in samples for your pets! A \$99.00 donation will get you one sample collection kit:

<http://humanfoodproject.com/american Gut/>. There is also the private company in San Francisco, co-founded by researchers from UCSF and Stanford University, called uBiome. uBiome will provide a sample collection kit for your gut alone for \$89.00, with a variety of other kits available at increased prices. <http://ubiome.com/>.

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