Scientist study bacterial communities inside us to better understand health and disease

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The number of bacteria living within the body of the average healthy adult human are estimated to outnumber human cells 10 to 1. Changes in these microbial communities may be responsible for digestive disorders, skin diseases, gum disease and even obesity. Despite their vital imporance in human health and disease, these communities residing within us remain largely unstudied and a concerted research effort needs to be made to better understand them, say researchers today at the 108th General Meeting of the American Society for Microbiology in Boston.

“This could be the basis of a whole new way of looking at disease. In order to understand how changes in normal bacterial populations affect or are affected by disease we first have to establish what normal is or if normal even exists,” says Margaret McFall Ngai of the University of Wisconsin, Madison.

Researchers have long suspected and researched the role that beneficial microbial communities within humans, known collectively as the human microbiome, play in health and disease but only recently has molecular technology reached the point where they can truly begin to identify and characterize all the species that make up an individual’s microbiome.

Martin Blaser of New York University has been working to identify the various bacteria that live on the human skin and help to form a protective barrier on the outside. Before he started his research it was estimated that fewer than 100 different species of bacteria lived on the skin. Using relatively new DNA-based sequencing techniques, he and his colleagues attempted to identify the bacterial species on the forearms of healthy subjects.

An initial study of six subjects identified 182 bacterial species. Subsequent studies continued to add more species to the point where Blaser now estimates the number of different bacteria species living on the skin could approach 500.

Despite these numbers Blaser notes that only about 10 species predominate, accounting for approximately 50% of the total population.

“What was interesting about some of the other species with smaller populations is that they were host specific. We could only identify them on a single host. It is entirely possible that everyone could have a unique bacterial signature,” says Blaser, much in the same way eveyone has a unique DNA signature or a unique fingerprint.

Blaser is also beginning to explore the role these may play in skin disease and that research may be paying off. Initial studies of patients with psoriasis suggest differences in skin bacterial populations between patients who have the disease and those who do not.

Daniel Frank of the University of Colorado, Boulder, is part of a team that is exploring the role bacterial communities in the human digestive tract may play in inflammatory bowel diseases. They are collecting and comparing microbial communities in samples from people with Crohn’s disease, people with ulcerative colitis and healthy volunteers.

“Some researchers are looking at the role a specific organism, like E. coli, might play in the development of inflammatory bowel disease. Our task was to look more broadly. What are the microbes we see as a whole in the gut and how might those populations change in relation to disease?” says Frank.

Instead of any one particular organism associated with inflammatory bowel diseases, they observed significant shifts in microbial populations between healthy subjects and those with disease, including a loss of normally protective bacterial populations.

The bacteria in the digestive tract could also play a role in obesity. Ruth Ley of Washington University in St. Louis is part of a team that has been investigating the relationship between bacteria in the gut and weight. Several years ago they discovered that obesity was associated with changes in the relative abundance of certain types of bacteria in the digestive tract.

Due to their overwhelming numbers, the fact that their byproducts can be found in most human fluids, and the evidence of their potential role in health and disease, it is quite possible that mapping and understanding the human microbiome may be as important or more important to understanding human health than mapping and understanding the human genome, says McFall Ngai. Either way, with the complexity of the system, it is definitely going to be more difficult.

Recognizing its importance, the National Institutes of Health in December 2007 announced the Human Microbiome Project as part of its Roadmap for Medical Research, devoting over $100 million in grants over the next five years. Researchers will use new, comprehensive laboratory technologies to characterize the microbial communities present in samples taken from healthy human volunteers, even for microbes that cannot be grown in the laboratory. The samples will be collected from five body regions known to be inhabited by microbial communities: the digestive tract, the mouth, the skin, the nose, and the female urogenital tract. Research projects will subsequently be funded to sample the microbiomes from volunteers with specific diseases. This will allow researchers to correlate the relationship between changes in a microbiome present at a particular body site to a specific illness.

Source: American Society for Microbiology