Friendly viruses in the intestine are unique - even among identical twins

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(PhysOrg.com) -- Many people associate viruses with disease. But a largely unexplored world of viruses make their home in the lower intestine, and new research at Washington University School of Medicine in St. Louis suggests that each of us harbors a unique collection of these 'friendly' viruses.

In a study of healthy identical twins - all females - and their mothers, the researchers found that even identical twins carry distinctive collections of viruses deep in their intestines. The research is published July 15 in the journal *Nature*.

Unlike viruses that make us sick, these viruses are not predators. Indeed, most of them are novel and live a cozy existence inside bacteria that naturally reside in the gut. Here, the viruses are thought to influence the activities of gut microbes, which among their other benefits allow us to digest certain components of our diets, such as plant-based carbohydrates, that we can't on our own. Further, the viruses may act as a barometer to gauge the overall health of the gut microbial community as it responds to challenges or recovers after an illness or therapeutic intervention.

"Viruses are the major predators on planet Earth," says senior author Jeffrey Gordon, MD, director of Washington University's Center for Genome Sciences and Systems Biology, whose pioneering research has provided an understanding of the nature of the microbes that live in our intestines: how they are acquired and how they benefit us, including their

influence on nutrition.

“Much of the information we have about viruses that live together with bacteria comes from studies of environmental habitats, like the ocean,” Gordon says. “There, the lifestyle of viruses can be described as ‘predator-prey dynamic’ with a continuous evolutionary battle of genetic change affecting viruses and their microbial hosts - a battle that shapes the structure and dynamic operations of these microbial communities. We wanted to know the nature of viruses and their lifestyle in the most populous microbial community that inhabits our bodies - the one in our gut.”

In the new study, led by graduate student and Fulbright scholar Alejandro Reyes, the scientists decoded the DNA isolated from viruses in stool samples provided by four identical twin pairs and their mothers. The investigators sequenced the viral DNA - or viromes - from stool samples collected at three different times over a one-year period, which enabled them to track any fluctuations in viral communities over time. The researchers also sequenced the DNA of all the microbes - the microbiome - in the women’s stool samples, which allowed them to compare the viral and microbial communities in the lower intestine.

Remarkably, more than 80 percent of the viruses in the stool samples had not been previously discovered.

“The novelty of the viruses was immediately apparent,” Gordon says.

Every individual in the study carried a distinctive viral “fingerprint” in the lower intestine, the researchers noted, even genetically identical twins. The intestinal viromes of identical twins were about as different as the viromes of unrelated individuals. That’s in contrast to gut bacteria. When the researchers looked at the bacterial communities in the stool samples, they found that family members shared a certain degree of the

same microbial species.

Despite the distinctive variations in the viral communities from one person to the next, the researchers discovered that the predominant viral species present in each individual's lower gastrointestinal tract remained genetically stable and persisted over the one-year study. This differed from the bacterial communities, which experienced greater fluctuations. In other words, the DNA viruses in the stool specimens did not appear exhibit the predator-prey lifestyle seen in environment communities, Gordon says. These viruses contained evolving bacterial genes that encoded functions that could benefit their bacterial hosts as well as other bacterial species present in the gut.

The researchers now plan to study the viromes in the developing intestines of infant twins - identical and fraternal - from different families to determine how viruses first "set up shop" in the gut ecosystem and how they are influenced by the nutritional status of their human hosts. In addition, to better understand viral lifestyles throughout the length of the intestine, they are introducing these viruses into mice that only contain human gut microbes.

In recent years, a number of projects worldwide have been initiated to catalog the microbes that live in and on the human body, with the goal of understanding the relationship between microbial communities and overall health and disease. The new research suggests that such projects should also turn their attention to the viruses that co-exist and co-evolve with bacteria and other microbes that normally live in our bodies.

More information: Paper link: www.nature.com/nature/journal/ … ull/nature09199.html

Provided by Washington University School of Medicine in St. Louis

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