Simulation could help explain nutrients' impact on gut

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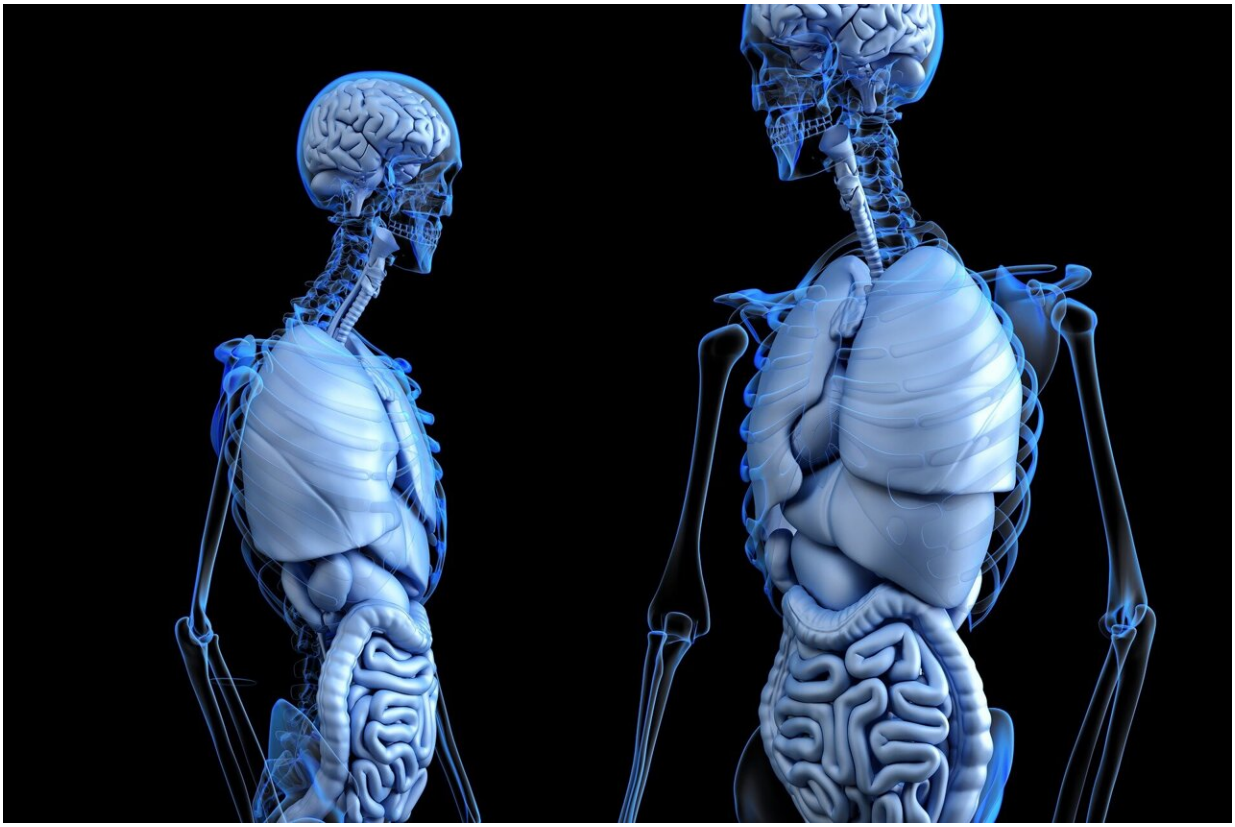

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The human gut is an extraordinarily dynamic place, with millions of interactions between microbes, bodily processes and chemicals taking place every minute.

This dynamic gastrointestinal interplay has an important role in our health, however, the relationship and interaction between the different members of this microbial community and how groups of nutrients and supplements shape them have largely remained underexplored.

Research led by a team at the University of Sydney is shedding light on the importance of this communal interplay and how nutrients and vitamins may 'modulate' or influence gut microbiota communities.

The researchers, who are developing a computational tool that relies on metabolic simulation—recently published in *Gut Microbes*—tests the impact of nutrient combinations on gut microbes. While some gut bacteria, such as Bacteroides, are able to create their own vitamins even when they are scarce or absent in a person's diet, the researchers found that other gut bacteria communities, such as Prevotella do not possess this quality and appeared to require vitamins from food or other members of the human microbiota.

"The human gut microbiome structure and activities impact human health, yet what drives the interplay between various microbiota members remains underexplored," said Dr. Juan Pablo Molina Ortiz, a medical doctor and Ph.D. researcher within the Centre for Advanced Food Engineering and Charles Perkins Centre.

"In our recent study, we found that vitamin supplements may also play a role in shaping this community—however, it is more likely that gut microbes complement each other's vitamin needs."

The researchers say these insights could help develop new approaches to diet—a complex area when considering the diversity of individuals' microbiomes.

"On one hand, this could lead to tailored diets which help in improving

or restoring individuals' microbiome that aim to improve health outcomes. However, our findings also pose the question of how we are altering these dynamics and what are the health impacts?"

Dr. Erin Shanahan, a postdoctoral researcher in the School of Life and Environmental Sciences, said that tool helps to explain how different strains of bacteria interact in the gut which appear to exhibit behaviours much like a large, complex social network.

"One way of thinking about our work is that it is a bit like "The Sims" computer game—but for microbes. The simulation helps us understand bacteria networks and how different communities interact with and influence one another."

Dr. Shanahan also said that while there are variations in individuals' microbiomes, overall, there were certain patterns that determined gut health.

"We see distinct patterns when looking at the interactions between a fibre-rich diet and a Western-style diet. Some of the bacteria associated with these patterns in the gut microbiome have differing abilities to synthesise vitamins for themselves. This has not previously been assessed at such a large scale across such a large variety of gut microbes."

The researchers studied the interactions of B vitamins, including B1 and B12, as well as Vitamin K2 and CoQ8—a coenzyme. B7 (biotin) and K1 were not included. Vitamin supplementation was not tested in this study, however the researchers hope to further investigate the impact of supplementation using the simulation.

The researchers say the tool can be used to explore other aspects of the human diet and gut, such as carbohydrates and amino acids.

"We hope that doing so will contribute to a greater understanding of why some individuals have an improved responses to a tailored diet while others don't, by examining the way in which gut microbes metabolise and share nutrients."

More information: Juan P. Molina Ortiz et al, High throughput genome scale modeling predicts microbial vitamin requirements contribute to gut microbiome community structure, *Gut Microbes* (2022). DOI: 10.1080/19490976.2022.2118831

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