Bug guts map brings scientists closer to understanding different bugs' role in the body

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Scientists have made a major step towards understanding precisely which bugs in the gut are involved in which processes in the body, by mapping the different species of bugs living in seven members of the same Chinese family.

Bugs in the gut are known as gut microbes and trillions live symbiotically inside the human body. Different people can have very different populations of gut microbes living inside them.

The makeup of each person’s gut microflora influences their health, and abnormalities in gut microbes have been linked to diseases such as diabetes and obesity.

Research has already shown that the makeup of an individual's gut microbes is can be changed by their diet and other environmental factors. Scientists are hopeful that many diseases could be tackled by creating drugs that target different gut bugs and correct abnormalities in them.

However, although it is known that gut bugs are involved in many of the body’s processes, the relationship between different species of bug and different processes has previously been defined only at a broad level, mainly concentrating on the metabolism of fat.

This is partly because it is difficult to observe the interactions inside a living human body in such microscopic detail. Mapping the species of gut microflora inside a person requires DNA fingerprinting of the bugs and detailed analysis is extremely complex and expensive. Prior to the new study, only five people in the world had ever had their gut microflora profiled in depth and had these data published.

The new study is a major step towards fully defining how different gut bugs affect the metabolism – the chemical reactions inside the body that keep it working, for example in converting food into energy or in maintaining cells.

The researchers believe that once they have a complete map of the interactions between the bugs and the metabolism, they will be able to use metabolic information to determine the makeup and function of a person's gut microflora, and then find new ways to treat different diseases by targeting specific gut bugs and engineering their interactions with the host.

The new study brings researchers closer to creating this system of translating the makeup of a person's gut bugs by analysing their metabolic profile.

The research gives scientists a much better idea of which bugs are particularly key. For example, the researchers found that a common "friendly" species of gut bug known as Faecalibacterium prausnitzii was statistically linked to the presence of eight diverse chemicals involved in metabolism, suggesting that this bug plays a key role in co-regulating multiple metabolic processes.

Professor Jeremy Nicholson, lead author of the study from the Department of Biomolecular Medicine at Imperial College London, explained: "It's now widely recognised that gut bugs play an important

part in people's health but we don't know which of the hundreds of different species of gut microbes have the biggest influence on us, or exactly how they are involved in the thousands of processes inside the body. Our new study has enabled us to see and map to a greater extent than ever before how the bugs interact with the body.

"Now we have developed a new way of exploring the connections between bugs and man we can hope to find a 'Rosetta Stone' to translate the functional properties of the bugs and so improve therapies to treat disorders of the gut and related conditions," he added.

The study also showed that the Chinese individuals had different bacteria at the species level to the five American individuals profiled in previous studies. This suggests that there are significant differences in the metabolisms of people from the two countries, which are not just down to their own genetic makeup. The researchers suggest that these differences should be taken into account when looking at people's risks of different diseases in the two countries.

Prof Liping Zhao, coordinator of this project and senior author leading the microbial analysis from Shanghai Centre for Systems Biomedicine at Shanghai Jiao Tong University, indicated that this new methodology is a significant step toward understanding whole-body systems biology or global systems biology.

"Simultaneous molecular profiling of gut microbiota and host metabolism of a large cohort of people for a reasonably long time can lead to discovery of pre-disease biomarkers representing typical changes during the transition stage from health to disease in chronic conditions such as cancers or metabolic syndromes. This can eventually lead to effective management of public health in a predictive and preventive manner," he said.

For the study, scientists used DNA fingerprinting of the gut microflora to gain a picture of which species of bug were living inside each of the seven volunteers. Each volunteer had a different makeup of gut bugs inside them, even though they were members of the same Chinese family and therefore were closely linked in genetic and lifestyle terms.

The scientists compared the variations in the volunteers' gut microflora with the variations in their metabolisms. They determined the metabolic profile of the volunteers by analysing samples from their faeces and urine, using NMR spectroscopic urinary profiling.

The volunteers in the study were four generations of the same family, six living in China and one in the UK. Three were males, aged between 18 and 55, and four were females aged between 1.5 and 95. Although the sample size was small, this is still the largest survey of its kind to date and the study represents two years' work.

Source: Imperial College London