

Get the scoop on

MENTAL HEALTH

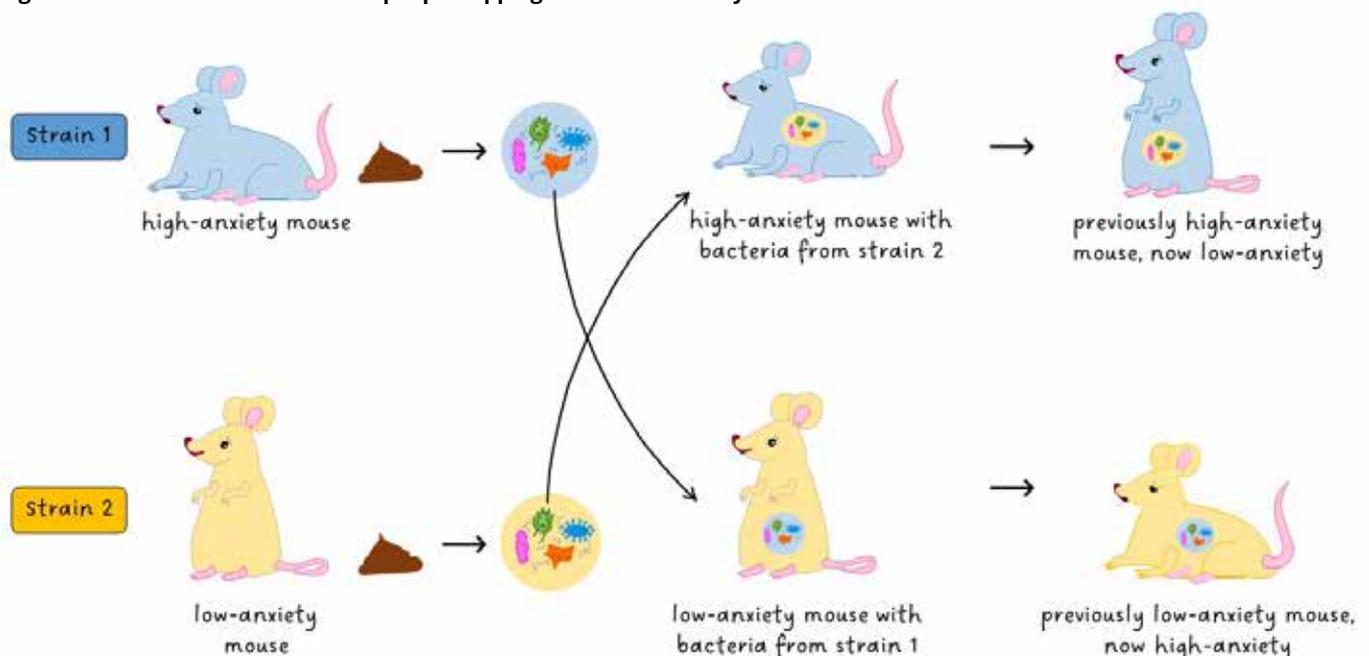
and poop!

The trillions of microscopic organisms that live in our gut and make up our microbiome can play a significant role in our mental health, how we perceive and respond to stress and potentially how anxious we are. Altering our gut microbiome may help us treat mental health disorders like anxiety.

It may give us the heebie-jeebies to think about trillions of microscopic organisms squirming around inside and all over us – however, they play a significant role in our physical and mental health, and cannot be ignored. These complex communities of microbes, including bacteria, viruses and fungi, are collectively known as the human microbiota. They can be found on our skin, in our nose and mouth, and especially in our gut (mainly the large intestine). The gut microbiota, together with the DNA of these microbes, is referred to as the gut microbiome.

Most of the gut microbiome consists of bacteria, the number and species-composition of which can drastically change depending on lifestyle factors such as diet, antibiotic use, and stress levels. However, not only do we influence the microbiome, but the composition of the microbiome can significantly influence us, as it can affect our immune system, how we metabolise foods and medicine, and importantly, our mood and behaviour. In fact, these effects are so profound that some researchers have called the gut microbiome the last human organ to be discovered. However, the idea that our gut is associated

Figure 1: Illustration of the effect of 'poop-swapping' in mice on anxiety-like behaviour



with our emotions has been around for thousands of years (just think of the terms “gut feelings” and “gut instincts”) – so maybe we’ve unknowingly acknowledged the gut microbiome for longer than we think!

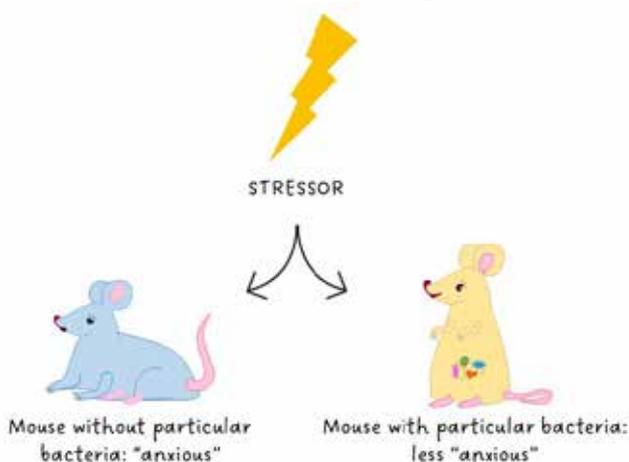
Many studies have been done in animal models to provide evidence that the gut microbiome has a significant impact on behaviour. One such study looked at two strains of mice – one strain exhibits anxiety-like behaviour, and the other a more relaxed behaviour. After microbes from faecal matter were transplanted from one strain to the other (essentially a ‘poop-swap’), the previously highly anxious mice showed more relaxed behaviour, and the previously relaxed mice showed more anxious behaviour (Figure 1).

Another study exposed mice to a stressful situation, while recording their anxiety-like behaviour. After this, scientists introduced a certain type of bacterium (a particular *Bifidobacterium* species) into the gut of those mice. When exposed to the same stress, this time with the new bacteria present in their gut, the mice exhibited less anxiety-like behaviour than before. This shows us that something as simple as adding one type of bacteria to the gut microbiome can significantly change behaviour (Figure 2).

But how does this work? Well, the human body is complex, and its working can be compared to that of a busy city with many roads and cars. To address stressful situations that arise in the city, there are response vehicles, such as fire trucks and ambulances. During these situations, some roads may close to allow the emergency vehicles to deal with the situations.

Similarly, the human body has a method of responding to stress. It has its own ‘vehicles’ that are part of the stress response – these are molecules known as hormones and neurotransmitters, and these can affect how happy, sad or anxious we feel. To control the concentration of these molecules (which molecules and how many of them are present), the body has pathways that work like roads – sometimes some routes need to close, and some vehicles need to be redirected to ensure that the right vehicles reach the right place at the right time.

Figure 2: Illustration of different stress responses in mice before and after the introduction of certain gut bacteria



This is where the gut microbiome comes in – not only can it produce hormones and neurotransmitters, but it can also affect the pathways that regulate these molecules; this is how it affects our mental state.

Although we understand some of the mechanisms of how the gut microbiome affects mental health, there are still a lot of unanswered questions, such as what makes a gut microbiome ‘healthy’, which microbiota (or combination thereof) are ‘good’ or ‘bad’, how exactly does the microbiome communicate with the brain, how does the microbiome interact with environmental and genetic factors to collectively influence mental health, and many more.

To address some of these questions, researchers at Stellenbosch University are studying what kinds of microorganisms live in our gut and whether they differ based on mental health status. As part of the saNeuroGut Project, participants (> 18 years) volunteer to send of their stool samples to the lab, from which researchers extract and sequence microbial DNA. Sequencing is a method to determine the order of nucleic acids (the building blocks of DNA). The sequence of certain regions of DNA (in the case of bacteria, the 16S rRNA gene) can tell us which types of bacteria are present in our gut microbiome. Once we know which bacteria are present, we can investigate how they interact with human physiological mechanisms. For instance, certain bacteria may produce chemicals that interact with the immune and stress response systems to alter the pathway of molecules that communicate with the brain, possibly resulting in psychiatric disorders, such as anxiety and depression.

This is why studying the gut microbiome is so important: if we can identify the gut microbial composition associated with good mental health, we may be able to use the gut microbiome as a therapeutic target to treat mental disorders.

South Africa has a high prevalence of mental health disorders, but our rich culture and diverse population provides an opportunity to investigate many factors that may alter the gut microbiome and how this relates to mental health. The saNeuroGut Project intends to mark South Africa’s contribution to this growing area of research and uses a citizen-scientist approach, thereby creating a space in which to communicate, educate and engage with participants. So, just as you should follow your gut, follow us through this research journey via Facebook page – SA NeuroGut.

Written by Michaela O’Hare , Karlien van Rooyen , Patricia Swart  and Sian Hemmings . The authors are part of the saNeuroGut Project which explores the role of the gut microbiome in mental health disorders, specifically depression, anxiety and posttraumatic stress disorder. The saNeuroGut Project is an ongoing study in the Neuropsychiatric Genetics group in the Department of Psychiatry at Stellenbosch University (www.saneurogut.org).