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Let's Talk

Your Microbiome and You

What is the microbiome?

You may have heard people talking about the "**microbiome**", "**microbiota**" or "**microflora**". These terms all refer to the vast community of microorganisms (such as bacteria, yeasts and viruses) which reside in and on the human body. We're absolutely teeming with them, from the **oral cavity**, and **genitourinary tract**, to the **skin** and **lungs**.

In fact, latest research suggests **we are home to as many bacteria as we are human cells**,[1] and that the microbiome collectively weighs more than our brain![2] By far the biggest community of microorganisms is in the gastrointestinal tract, which houses around **100 trillion bacteria** in the large intestine.[1]

Different species have different requirements, such as pH, nutrition sources and oxygen levels, needed to thrive. Therefore you will find different species colonising in different areas of the digestive tract. It is estimated that around **10,000 different bacterial species** make up the human microbiome, with each individual housing around 500-1000 species in their gut.[3]

Some species of microbes are beneficial (providing us with a health benefit), some are benign (they have no effect on us that we are yet aware of), and others are pathogenic (potentially disease-causing if allowed to get out of hand). They can all live harmoniously together as long as levels of each are balanced.

Where imbalances occur, this is known as dysbiosis, which is associated with a number of negative health consequences.[4]


Mental wellbeing
Immunity
Gut

The Microbiota-Gut-Brain Axis

The gut-brain axis, and in particular how the balance of bacteria in the gut may affect brain health and mood, is an exciting and rapidly evolving area of research. The gut-brain axis is a two-way communication system between the gut and the brain. It consists of nerve, immune and hormonal pathways, all of which may be influenced by our gut bacteria.[42] For example, 80% of signals sent along the vagus nerve connecting the brain to the gut originate from the gut, and only 20% from the brain.[43] These signals are influenced by neurotransmitters such as serotonin created in the gut by certain species of bacteria.[43] Interestingly, research is implicating changes in the gut microbiome caused by diet and lifestyle factors, in a variety of mood and cognitive-related conditions.[44]

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What does our Microbiome do for us?

Beneficial species of bacteria in the gut help to support good health in a number of different ways. For example:

- They **help to protect** us against pathogens (disease-causing microbes). They do this via a number of different mechanisms including competing for nutrients and space on the gut lining (the less food and space there is for pathogens, the less likely they are to colonise) and secreting antimicrobial substances. They also help to **lower the pH** in the gut, making it more difficult for pathogens to thrive.[13]
- They **provide us with extra nutrition**. Certain fibres that we eat aren't digestible by humans, and it is only when they are fermented by our gut bacteria that we can derive some benefit from the by-products such as SCFAs.[14] Our gut bacteria also **synthesise vitamins** themselves such as vitamin K (needed for blood clotting) and B vitamins (needed for energy production).[14]
- They help **support detoxification** processes in the body by binding to heavy metals and toxins in the gut,[15,16] and reducing the workload for the liver.[17]
- They support the health of the gut lining, preventing intestinal hyper-permeability (known as "leaky gut"), which helps protect against inflammation.[18] A healthy gut lining also helps us to **absorb more nutrients** from our food.

Research suggests that the composition of the microbiome is crucial to developing organs including the gut, brain and the immune system,[12] so it's important to foster a healthy microbial balance from the outset.

What can negatively impact the microbiome?

Unfortunately, many aspects of modern life can negatively impact the microbiome, and as such we are seeing massive reductions in bacterial diversity in the human gut. For example:

Broad-spectrum antibiotics have been shown to disrupt the microbiome, as they are non-selective, indiscriminately killing both pathogenic and beneficial bacteria.[19] It isn't just antibiotics however, almost a quarter of the 1000 most commonly prescribed medications have been shown to have a potential impact on the microbiome.[20]

Western diets, high in processed foods, sugar, refined carbs and unhealthy fats, and low in fibre (which is the food source for beneficial species in the gut) can rapidly affect the microbiome,[21] with changes being shown in as little as 24 hours![22]

Environmental pollutants such as pesticides, chemicals, pollution, food additives, heavy metals and chlorinated tap water may also **negatively impact the microbiome**.[23]

Overly hygienic environments and lack of exposure to the outdoors (e.g. soil and animals) may also play a part in declining diversity, as we need exposure to a wide variety of microbes ("old friends") to help develop our gut flora and immune system.[24,25]

Our gut bacteria are also affected by **stress**[26] and **poor sleep patterns**,[27] which have been shown to reduce levels of beneficial species, potentially affecting neurotransmitter balance and mood.

As we get older we often see declining levels of certain types of bacteria.[28] This may in part be a natural shift, but is also likely a consequence of years of these diet and lifestyle factors.

The Microbiome and Digestion

Having a healthy microbiome is important to ensure regular bowel movements, as our gut bacteria help to regulate gut motility.[29] Some species of beneficial bacteria also help us digest our food by producing enzymes such as lactase, which helps break down lactose (the sugar found in milk).[30]

Dysbiosis (an imbalance of gut bacteria) is associated with numerous digestive conditions.[31] For example, a growing body of evidence indicates dysbiosis as a hallmark of Irritable Bowel Syndrome (IBS).[32] Bloating can be a sign of dysbiosis in the gut, as beneficial species of bacteria produce little (if any) gas when fermenting fibres,[33] whereas pathogenic species tend to produce more gas.

Our gut bacteria also **communicate directly with our immune system**, helping to strengthen our defences.[10]

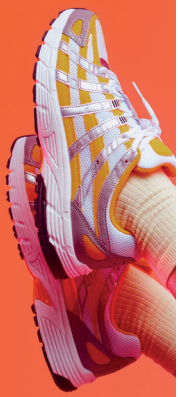
70%
of immune cells are located in the gut

The Microbiome and Immunity

You may be surprised to hear that over 70% of immune cells are located in the gut, where they interact with our gut bacteria.[34] Beneficial species play an important role in helping to support the immune system and protect us from pathogens. Where dysbiosis is present we are more susceptible to infections.[35] By supporting the health of the gut lining, beneficial species in the gut also help to prevent "leaky gut", which is a trigger for inflammation, and may even lead to autoimmunity,[36] where the immune system becomes so confused it starts to attack the body's own cells.

Evidence suggests that alterations to the microbiome during the 'critical phase' of immune system development (the first 1000 days of life starting at conception), could potentially have a negative impact on health later in life.[10] Supporting a healthy balance of bacteria in the gut during this early window is therefore important.

The Microbiome and Cognitive Health



Cognitive function refers to a range of abilities that we may often take for granted, including memory, learning and problem solving.[45] As we age, some of these abilities begin to decline, in fact our cognitive function usually peaks in our mid-20s.[46] Thanks to our gut-brain axis, the microbiome may support the health of brain cells through its influence upon inflammation and immune regulation.[47] Evidence suggests that inflammation within the brain and spinal cord (also called neuroinflammation), could be worsened by dysbiosis, leaky gut and stress.[48,49] There are a range of factors that might help prevent neuroinflammation, such as physical activity, brain stimulating activities, diet and improving cardiovascular health.[50] Additionally, keeping our gut microbiome balanced with a diverse range of species may help to prevent gut dysbiosis and therefore reduce inflammation.[48,51,52]

One of the important chemical messengers in the brain that appears to be supported by the gut microbiome is brain-derived neurotrophic factor (BDNF).[53] This protein is related to learning, memory and the maintenance of nerve cells.[53] Interestingly, levels of BDNF and other neurochemicals are thought to be imbalanced in those with mild cognitive impairment and some neurodegenerative disorders like Alzheimer's disease.[54,55] SCFAs, produced from bacterial fermentation of dietary fibre, may also support cognitive health, as they are able to cross into the bloodstream and also act upon the vagus nerve.[56] SCFAs are noted to support levels of neuroactive substances such as dopamine, serotonin and tryptophan, therefore could influence brain chemistry.[57]

Supporting our microbiome may also help with some of the factors that surround cognitive health, for instance sleep.[58,59] Disrupted sleep patterns have been associated with mild cognitive impairment with some evidence suggesting that improving insomnia may improve cognitive outcomes.[60,61] Certain species of bacteria in the gut may support relaxation and sleep through the production of serotonin (which is used to make melatonin – our sleep hormone)[62] and some specific strains of *Lactobacillus* bacteria have been found to produce the calming neurotransmitter GABA, which works synergistically with magnesium to guide the sleep/wake cycle.[63]

The Microbiome and Mood

Most people will have experienced low mood at some point in their lives. This may be due to a variety of reasons, such as relationship problems, trauma, stress or illness. Symptoms of low mood may include reduced energy levels, sadness, worry or anger.[64] The association between our microbiome and mood is becoming increasingly more established. Evidence has suggested that those with digestive complaints also tend to experience low mood, in fact one study highlighted a correlation between the prevalence of anxiety and depression and the number of digestive symptoms a person experiences.[65] The microbiota-gut-brain axis may support our mood through a variety of ways; by supporting energy levels,[66] providing additional nutrients[67] and perhaps even regulating our stress hormones and neurotransmitters.[56]

Our microbiome has the ability to influence levels of nutrients, such as B vitamins[67] and vitamin D.[68] These nutrients are vital for energy and immunity and are needed to produce active brain chemicals, such as serotonin, our 'happy hormone'.[69,70] Stress hormones such as cortisol may be implicated in low mood and although we may each react differently to stress, if we are enduring a significant level of chronic stress, it may impact our well-being.[71] The microbiome may influence how the body interprets a variety of stress-related compounds, potentially playing an important role in our stress response,[72] and evidence suggests that supporting the microbiome may have the ability to reduce circulating cortisol.[73]

Keeping our gut microbiome healthy may also support a healthy gut lining, modulate our immune response and reduce inflammation.[56] Higher levels of inflammation have been seen in those suffering with more severe mood issues, such as depression and bipolar disorder.[74] Therefore, supporting a healthy microbiome may promote good digestive health and consequently improve our mood.[65]

Did you know?

No two microbiomes are the same? Your microbiome is unique to you, much like your finger prints.[5]

Where does it come from and what shapes it?

The infant's gut microbiome lays the foundations for their future development and health.[6] However, we're still unsure whether this process begins during pregnancy or during the labour.

Babies born vaginally have bacterial communities which resemble their mother's vaginal microbiota, whereas babies born by C-section have bacterial communities which are similar to those found on the skin.[7] These microbes then serve as the 'starter culture' for the development of their own gut microbiome.

However, it appears that even during the pregnancy, the mother's gut microbiome may influence the development of their infant's microbiome.[8] Whilst the microbes themselves may not translocate from the mother's gut to the womb, it appears that metabolites (e.g. compounds such as short chain fatty acids (SCFAs) and folate) produced by the mother's gut microbes could influence the baby's development.[8,9] Therefore the mother's microbiome (gut and vaginal) may play an important role in the health and development of the infant.[10]

Following the birth, breastfeeding and skin-to-skin contact also play an important role in shaping the infant microbiome.[11] As we continue to age, our microbiome is continuously being shaped by our environment, diet and lifestyle.

The Microbiome and Genitourinary Health

Many people don't realise that the microbiome of the digestive, vaginal and urinary tract play an important role in helping to protect against genitourinary infections. For example, pathogens which cause urinary tract infections (UTIs) often originate from the gut and vagina.[37] The urinary tract and vagina share a similar microbiome, where *Lactobacilli* species tend to predominate.[38] Having adequate levels of beneficial *Lactobacilli* species is important to create an environment that protects against pathogens such as *Gardnerella vaginalis*, *Candida albicans* and *E.coli*, which can cause uncomfortable infections such as **bacterial vaginosis**, **vulvovaginal candidiasis (thrush)** and **UTIs**.[39,40,41]

How to look after your Microbiome

Research is indicating that having a diverse gut microbiome, with lots of different beneficial species is a key determinant for good health.[75] In order to encourage diversity in the gut, it's recommended to:

Eat a wide variety of different plant foods. Recent research shows the more plant foods you eat (ideally over 30 different types a week), the greater the diversity in the gut, regardless of other dietary factors.[76]

Eat plenty of foods high in prebiotic fibres such as garlic, onions, shallots, leeks, slightly under ripe bananas, Jerusalem artichokes, asparagus and dandelion greens, as these provide a food source for beneficial species in the gut.[77]

Reduce your exposure to environmental toxins by eating home-grown or organic where possible,[82] filtering your water,[83] and using natural skin care and home cleaning products.[84]

Take steps to reduce stress, such as signing up to a meditation or mindfulness course, cognitive behavioural therapy, or restorative exercise such as yoga.[26] Prioritise carving out time for yourself, even if it's just 15 minutes a day to take a bath or a walk, read a book or do some deep breathing exercises.

Introduce beneficial species to the gut by regularly consuming traditionally fermented foods such as kefir, live yoghurt, kimchi, sauerkraut, kombucha and miso.[78] These tend to be particularly high in beneficial *Lactobacilli* and *Streptococcus* species.[78] If fermented foods don't quite tickle your tastebuds, you may want to consider taking a multi-strain live bacteria supplement.

Increase your intake of polyphenol-rich foods such as berries, green tea, raw cacao, cloves, star anise, curcumin and other herbs and spices. Polyphenols are packed with antioxidants and are associated with numerous potential health benefits, including increasing beneficial species of bacteria in the gut and inhibiting pathogens.[79]

Regularly spend time outdoors and near animals, for example by taking country walks, signing up to an exercise class in the park, visiting farms and animal sanctuaries or walking a neighbour's dog.[80,81]

Introduce a regular bedtime routine,[85] by getting up and going to bed at the same time each day. Ensure your bedroom is dark and cool enough and practice good sleep hygiene by avoiding screen use for at least an hour before bed and keeping electronic devices out of the bedroom.[86]

References available on request.

Need further information?

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