

## The Microbiome: Nurturing the Microbiota Within

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### Key Messages

- The human microbiome includes the entire collection of microbes living in and on the human body.
- What we eat can have a significant impact on our gut microbiome.
- Dysbiosis is a disturbance in the gut microbiome and is associated with chronic disease.
- Probiotics and prebiotics can help create a healthy gut microbiome.



### Defining the microbiome

The microbes living in and on us carry out key functions necessary for optimal health and well-being. The functions of these microbes are so vital to health that the gut microbiome is now claimed to be a [new organ system](#).<sup>1</sup>

The human microbiome is a term used to describe the entire collection of microbes and their genes living in and on the human body.<sup>2</sup> The microbes, often referred to as “microbiota” are made up of bacteria, fungi and viruses. They live in our mouth, nose, skin, digestive tract (gut) and vaginal tract. Various parts of the body have different microbiomes, for example, the skin microbiome is different than the gut microbiome, but they all are part of the human microbiome.

The gut microbiome is quite diverse compared to other body sites. There are trillions of microbes living in our gut, about ten times more than there are human cells.<sup>3</sup> More than 1000 different species have been discovered. These microbes carry genes that have important functions in our body. However, scientists only understand a small fraction of their many functions.

Despite the improved understanding of what is living in and on us, the actual definition of a “healthy” gut microbiota is not fully understood. Humans do have a common set of microbes but the microbes vary between individuals.<sup>4</sup> We know that one-third of our gut microbes are common to most people, while two-thirds are specific to individuals.<sup>4</sup> Each person has at least 500 unique species living in and on their bodies. Research suggests that increased variety and numbers of the microbiota are associated with greater overall health.<sup>3</sup>

### The development of our microbiota

The microbes in our gut are needed for a healthy immune system, production of essential nutrients and vitamins and breakdown of foreign materials. Our gut microbiota is established very early in life, starting in pregnancy.<sup>5</sup> This process continues at birth, when the infant comes into contact with the mother’s vaginal microbiota in the birthing canal. How the baby is delivered influences the microbiome of the infant and may have long-term impacts on health. C-section delivery disturbs the normal colonization of the infant gut by preventing exposure to the mother’s

microbiota. The gut microbiota of infants delivered by C-section delivery appears to be less diverse, in terms of microbial species, than the microbiota of vaginally delivered infants.<sup>6</sup>

Infant feeding also has an impact on the gut microbiota of the infant. It is clear that the microbiota of breast-fed infants differs from that of formula-fed infants. The microbiota of infants that are breast-fed is dominated by Bifidobacteria which is considered good bacteria.<sup>7</sup> In contrast, formula-fed infants develop a more diverse microbiota with more unhealthy bacteria.<sup>7</sup> It has been established that some prebiotics and probiotics that have been added to infant formulas have the ability to alter the composition of the microbiota in the gut.<sup>8,9</sup> However, due to a lack of scientific evidence, the long-term impacts of these formulas on the infant's developing immune system are not known.<sup>10</sup>

Early in the infant's life, the microbiota is considered highly variable and unstable.<sup>4</sup> Around the age of three, the microbiota begins to resemble that of adults and becomes more diverse and stable.<sup>11</sup> Genetics, antibiotics, geography and living conditions continue to impact the composition of the adult gut microbiota. Diet is one of the key factors that impacts the adult gut microbiota.<sup>12</sup>

### All disease begins in the gut

The healthy gut microbiome is said to be a finely balanced network with multiple functions and



*Lactobacillus* bacteria

Source: istock.com/luismmolina

interactions that are vital to health.<sup>13</sup> For example, the microbiota play an important role in food digestion, regulation of the immune system and protection against pathogens.<sup>14</sup> This is a cooperative relationship, where the human provides a nutrient-rich setting for the microbiota to live while the microbiota carries out its many functions in the body.

A shift in the microbiota results in a disruption of this finely balanced relationship resulting in "dysbiosis." Dysbiosis is a disturbance in both the make-up and function of the microbes living in our gut.<sup>15</sup> There is a loss of beneficial microbes in favour of an increase in the pathogenic microbes, as well as a loss in diversity of microbes. In the last decade, these changes to the microbiota have been associated with a number of chronic diseases such as obesity, allergies, diabetes and a variety of inflammatory diseases. The link between the microbiota and the development of chronic disease appears to be related to the development of a low grade chronic inflammation which alters the immune system.<sup>16,17</sup>

### We are what we eat

While the exact reason for the rise in chronic diseases has not been found, what we eat is believed to have a significant impact on the microbiome. More and more research is pointing to the "Western diet" as having a negative effect on the microbiome.<sup>17</sup> This diet is high in refined sugar and fat combined with a low intake of fruit, vegetables and fibre.<sup>18</sup> The "Western diet" has been shown to negatively alter the composition of the gut microbiota. It is thought that these negative effects on the microbiota stimulate inflammation, typical of that observed in a number of chronic conditions.<sup>17</sup> Plant-based diets, such as the Mediterranean diet<sup>19</sup> and vegetarian diets,<sup>20</sup> are associated with positive changes to the gut microbiome, resulting in decreased inflammation.

Prebiotics and probiotics can help create a healthy gut microbiome. Prebiotics are defined as "non-digestible food compounds, that when metabolized

by the microbes in the gut, result in specific changes to the composition and/or activity of the gut microbiota.<sup>21</sup> The changes in the composition/activity of the gut microbiota lead to the beneficial effects on health. When prebiotics reach the colon they are fermented by the microbes, producing short chain fatty acids (SCFA), mainly acetate, propionate and butyrate.<sup>22</sup> SCFA affect the microbial ecology of the gastrointestinal tract and influence gut metabolism and function.<sup>22</sup> Fructo-oligosaccharides (FOS) and inulin are the most well recognized prebiotics.

An expert panel from the International Scientific Association for Probiotics and Prebiotics recently released a [consensus statement](#) on the scope and appropriate use of the term probiotic.<sup>23</sup> The statement endorsed the FAO/WHO (Food and Agricultural Organization/World Health Organization) definition of probiotics as “live microorganisms that, when administered in adequate amounts, confer a health benefit on the host”.<sup>23</sup> The panel found this definition has been widely adopted and also captures the essence of probiotics as microbial, viable and beneficial to health.<sup>23</sup> The distinction between commensal microbes in the gut and probiotics was also inferred with this definition.<sup>23</sup> Probiotics are consumed either as functional foods or supplements.

Probiotics help to maintain health and fight disease. Keep in mind, different types of probiotics have different effects. When recommending a probiotic, it is important to consider the following:



choose the appropriate strain (how the probiotic will function in the body), in the right dose, for the duration recommended for the health concern or symptom you want to relieve.

### Feeding the microbiota

We are only beginning to understand the importance of the microbiota in health and disease, but science is turning to how we can change our gut microbiota. While scientists have not reached agreement on what the best diet is to maintain a healthy microbiome, some general advice that can be provided:

**Fibre** – fruit, vegetables, whole grains, beans, peas and lentils

- There is strong research that shows that fibre has positive effects on the gut microbiota. A high fibre diet increases the diversity of the microbiota and encourages the growth of the beneficial microbes. Our microbiota feasts on fibre—which comes from various foods such as fruit, vegetables, whole grains, beans, peas and lentils.

*Women should aim for 25 grams and men should aim for 38 grams of fibre daily.*

**Fermented Foods** – yogurt, kefir, sauerkraut, kimchi, tempeh, miso

- Fermented foods have long been associated with health benefits.<sup>24</sup> Fermented dairy products such as kefir and yogurt have been shown to improve cholesterol metabolism, prevent gastrointestinal infection and enhance the immune system and the gut microbiome.<sup>25,26</sup>

*Include fermented foods in your diet for their “live, active cultures” that are linked to health benefits.<sup>24</sup>*

### Probiotics

- Supplementing with probiotics is a key way to improve gut health. For more information on probiotic foods and supplements, including dosage and indications, see the [2016 Clinical Guide to Probiotic Supplements](#).

*Healthy individuals should choose a probiotic product that has a variety of probiotic strains, containing at least 10-15 billion colony forming units (cfu).*

### Prebiotics

- Prebiotics encourage the growth of beneficial microbes such as Lactobacilli and Bifidobacteria. Inulin and FOS are naturally found in foods like onions, artichoke, garlic and asparagus. Inulin is also available in supplement form (extracted from chicory root) and added as an ingredient to many foods like cereals, granola bars and yogurt.

*Aim for 10 grams of inulin daily. [See this table for the content of inulin and FOS in common foods.](#)<sup>27</sup>*

In summary, our microbiota is essential to health. Although attempts to manipulate the composition of the gut microbiota by varying the diet have been successful, only a limited number of human studies have been done in small sample sizes and these have been conducted over a short period of time. Stay tuned! This fascinating area of science will change our understanding of health and disease.

This issue of Nutrition File® for Health Educators was written by Natasha Haskey.

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### Recommended Resources

For consumer resources on fermented foods, prebiotics and probiotics, see the [International Association for Prebiotics and Probiotics](#).

As a professional to stay abreast of the science in the microbiome, follow the [Gut Microbiota for Health](#).

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