Digestive Health

The Human Microbiome

What it is, Why it Matters, and How to Maintain it

Standard Process®

WHOLE FOOD NUTRIENT SOLUTIONS

Table of Contents

What is the Human Microbiome?	3
How the Microbiome Works in our Bodies	6
The Microbiome Throughout Our Lives	9
The Importance of Human Milk Oligosaccharides	12
The Relationship Between the Microbiome and Gut Health	14
The Relationship Between the Microbiome and Immune System Strength	16
Building the Human Microbiome	18
What Makes an Unhealthy Human Microbiome?	22
What Makes a Healthy Human Microbiome?	26

What is the Human Microbiome?

Along with our own cells, trillions of microorganisms live in our bodies. These microorganisms — including bacteria, viruses, and fungi — make up our body's microbiome. The inhabitants of the microbiome interact with each other and their environment to shape human physiology and pathology.

Understanding the Terminology

Human Microbiome: An inclusive term for the habitat of our body's microorganisms that includes their genomes and environment

Microbiota: A term for group of microorganisms that focuses specifically on the effect on human health outcomes. Microbiota include bacteria, viruses, fungi, protozoans, and other microorganisms.[1]

Microorganism/Microbe: A microscopic organism, such as a bacterium, virus, or fungus

The human microbiome begins to develop before birth and evolves over time — from infancy to old age. The status of the microbiome — whether healthy, unhealthy, or somewhere in between — influences nearly all body systems by affecting:

- Gene expression
- Immunity
- Nutrient absorption
- Energy metabolism
- Integrity of the gastrointestinal (GI) tract

Where the Microbiome Can be Found

Human microbiomes are found in the skin, mouth, gastrointestinal (GI) tract (the "gut"), and more. This eBook focuses on the gut microbiome, which is found in the GI tract and spans from our esophagus to our small intestine. The human gut microbiome alone holds a vast number of our body's microorganisms.

1. Lederberg J, McCray AT. (2001). 'Ome Sweet 'Omics - A Genealogical Treasury of Words. Scientist, 2001, 15(7), 8. https://lhncbc.nlm.nih.gov/publication/lhncbc-2001-047

Understanding the Terminology

The **metabolome of the human gut microbiome** describes all of the "raw materials and products" produced by gut microorganisms, plus those encountered in the microorganisms' environment.

The Metabolome of the Microbiome

The metabolome — the end products/byproducts — of the microbiome is largely influenced by the nutrients we consume in our diets, especially over a consistent, long-term dietary pattern. Unfortunately, this means that only one day of healthy eating will not reverse the negative effects on the microbiome that occur as the result of a committed pattern of unhealthy eating. Our dietary patterns can be characterized in vitro and subsequently be associated with various risk levels for long-term health effects.

How the Microbiome Works in Our Bodies

The gut microbiome can have a positive or negative influence on our health. This largely depends upon the interactions between the foods we eat, the nutrients those foods contain, and the metabolome of the microbiome.

The microbiome can influence:

- Digestive health
- Immune health
- Brain health

And that's just the beginning.

Understanding the Terminology

Microbes that are part of the microbiome are often defined as "biotics." Each "biotic" plays a unique role within the ecosystem that is the human body, and they start their work in the gut. Knowing where these "biotics" come from and how they can influence health can underscore their importance to a healthy microbiome.

More Biotics to Know

Synbiotic: A combination of both probiotics and prebiotics.

Phytobiotic: Phytonutrients from plants that influence the GI environment.

Psychobiotic: Organisms that positively influence host cognition.

Parabiotic: Inactive microbial cells that positively influence the host.

Postbiotic: Non-viable metabolic byproducts from bacteria that influence the host.

Biotics: The Famous Ones

Probiotic: Live microorganisms that positively influence microbiome and gut-related host health after consumption, including foods (yogurt and other fermented foods) and supplements. This works in essentially the same way as a prebiotic, but goes a different route to achieve the result. Probiotics add diversified bacteria to the microbiome, which improves the overall composition.

Consuming probiotics may positively alter the composition of the microbiome[2] by adding bacterial species, supporting the integrity of the intestinal barrier, and producing cytokines in the immune response.

Prebiotic: Substances obtained via diet or supplementation that circumvent digestion in the GI tract to feed gut bacteria. This can often result in either positive or negative compositional changes in the microbiome and/or benefits for gut health. This works by supporting commensal "good" bacteria and discouraging disruptive "bad" bacteria. Prebiotic supplements include:

- Human milk oligosaccharides (HMO) like 2'-FL
- Inulin
- Psyllium

Certain prebiotics, such as 2'-FL, are selective, supporting commensal "good" bacteria and discouraging disruptive "bad" bacteria.

2. Azad, M., Sarker, M., Li, T., & Yin, J. (2018). Probiotic Species in the Modulation of Gut Microbiota: An Overview. BioMed research international, 2018, 9478630. https://doi.org/10.1155/2018/9478630

Understanding the Terminology

Mutualistic and Commensal: These are the "good" bacteria that benefit from being a part of the human microbiome and also positively influence human health through the production of beneficial metabolites.

Disruptive: These are the "bad" bacteria that benefit from being a part of the human microbiome and also negatively influence human health through the expression of various detrimental virulence factors.

Types of Gut Bacteria

The bacterial species that live in the environment of our gut microbiomes all receive some sort of benefit from making their home in the human gut, whether that be a constant source of nutrition or other necessary resources such as space and binding sites. However, various bacterial species within the human gut microbiome differ in a fundamental way: the manner in which they influence their bacterial neighbors and their impact on our health.[3]

Mutualistic bacteria, either as natural inhabitants of the human microbiome or as ephemeral visitors in the form of probiotics, support human health by challenging disruptive bacteria:[4]

- Competition for shared micronutrients, carbon sources, and binding locations
- Antimicrobial secretions and toxin delivery targeting pathogenic bacteria

Mutualistic bacteria also support human health through the production of microbial metabolites:

- Short-chain fatty acids (SCFA) through the fermentation of dietary starches
- Breakdown of bile acids

Mutualistic/commensal bacteria in the gut include:[5]

- *Bifidobacteria*
- *Lactobacilli*
- *Firmicutes*
- *Proteobacteria*
- *Actinobacteria*

Disruptive bacteria in the gut include:[6]

- *Campylobacter*
- *Enterococcus faecalis (E. faecalis)*
- *Clostridium difficile (C. diff)*

3. Know Your Biotics. (2020, March 27). Retrieved December 22, 2020, from https://wholisticmatters.com/know-your-biotics/
4. Sassone-Corsi, M., & Raffatellu, M. (2015). No vacancy: how beneficial microbes cooperate with immunity to provide colonization resistance to pathogens. Journal of immunology (Baltimore, Md. : 1950), 194(9), 4081–4087. https://doi.org/10.4049/jimmunol.1403169
5., 6. King, C. H., Desai, H., Sylvetsky, A. C., LoTempio, J., Ayanyan, S., Carrie, J., Crandall, K. A., Fochtman, B. C., Gasparyan, L., Gulzar, N., Howell, P., Issa, N., Krampis, K., Mishra, L., Morizono, H., Pisegna, J. R., Rao, S., Ren, Y., Simonyan, V., Smith, K., … Mazumder, R. (2019). Baseline human gut microbiota profile in healthy people and standard reporting template. PloS one, 14(9), e0206484. https://doi.org/10.1371/journal.pone.0206484

The Microbiome Throughout Our Lives

In a way, the development of our microbiome starts at the very beginning of life, with the unique human genome playing a role in how microorganisms colonize and build stable communities within the human body.[7] However, the first significant environmental influence on our human microbiome is the method of infant birth: vaginal versus caesarean.

7. Goodrich, J. K., Davenport, E. R., Clark, A. G., & Ley, R. E. (2017). The Relationship Between the Human Genome and Microbiome Comes into View. Annual review of genetics, 51, 413–433. https://doi.org/10.1146/annurev-genet-110711-155532

A vaginal birth directly exposes a newborn to the microbiome of their mother's vagina during their journey through the birth canal.[8,9] Microbiomes of infants born via vaginal delivery typically contain predominate populations of *bifidobacteria*,[10] a known mutualistic species. This gut bacteria species is also associated with breastfeeding. *Bifidobacteria* produce short-chain fatty acids (SCFA), lactic acid, and other metabolic byproducts of fermentation. These bacteria are occasionally included in supplements such as probiotics due to their positive association with human health, mainly in the GI tract.

While less common than vaginal delivery, caesarean deliveries occur about 32 percent[11] of the time. Caesarean deliveries expose infants first to the mother's skin microbiome rather than the vaginal microbiome, including bacterial species such as:

- *Escherichia coli*
- *Clostridium difficile*
- *Bacteroides fragilis*
- *Lactobacilli*

8. Dunn, A. B., Jordan, S., Baker, B. J., & Carlson, N. S. (2017). The Maternal Infant Microbiome: Considerations for Labor and Birth. MCN. The American journal of maternal child nursing, 42(6), 318–325. https://doi.org/10.1097/NMC.0000000000000373
9. Neu, J., & Rushing, J. (2011). Cesarean versus vaginal delivery: long-term infant outcomes and the hygiene hypothesis. Clinics in perinatology, 38(2), 321–331. https://doi.org/10.1016/j.clp.2011.03.008
10. Portrait of a Supportive Microbe: Bifidobacterium. (2020, July 14). Retrieved December 22, 2020, from https://wholisticmatters.com/portrait-of-a-supportive-microbe-bifidobacterium/
11. FastStats - Births - Method of Delivery. (2020, April 20). Retrieved December 22, 2020, from https://www.cdc.gov/nchs/fastats/delivery.htm

Like the vaginal microbiome, the skin microbiome contains both helpful and harmful microbes, as well as some microbes that take both sides. Also like the gut microbiome, the composition of the skin microbiome varies widely due to a host of factors we'll discuss throughout this guide.[12] So while there are similarities between the gut and skin microbiomes, the composition of the gut microbiome seems to be a more suitable exposure route for newborns who are just beginning to collect microorganisms in their own microbiome.

After delivery, an infant's next major environmental exposure affecting microbiome composition is diet. This could consist of breastmilk, manufactured formula milk, or a combination of both. Breastmilk, and often infant formula, contains human milk oligosaccharides (HMOs), which act as prebiotic nourishment for a newly developing infant microbiome.[13]

Beyond infancy, through childhood, adulthood, and old age, our microbiome composition and its volume changes in response to new and changing environmental exposures. Changes to our microbiome can influence gut health, immune system strength, and more.

12., 13. Zhong, H., Penders, J., Shi, Z., Ren, H., Cai, K., Fang, C., Ding, Q., Thijs, C., Blaak, E. E., Stehouwer, C., Xu, X., Yang, H., Wang, J., Wang, J., Jonkers, D., Masclee, A., Brix, S., Li, J., Arts, I., & Kristiansen, K. (2019). Impact of early events and lifestyle on the gut microbiota and metabolic phenotypes in young school-age children. Microbiome, 7(1), 2. https://doi.org/10.1186/s40168-018-0608-z

The Importance of Human Milk Oligosaccharides (HMOs)

After delivery, an infant's next major environmental exposure affecting microbiome composition is diet. This could consist of breastmilk, manufactured formula milk, or a combination of both. Breastmilk contains natural human milk oligosaccharides (HMOs), galacto-oligosaccharides (GOS), inulin, and fructo-oligosaccharides (FOS), which act as prebiotic nourishment for a newly developing infant microbiome.[13]

While breastmilk may be the most advantageous way to affect an infant's microbiome, some mothers are unable to or choose not to breastfeed for a number of reasons, so adding HMOs to infant formula can help to improve the microbiome health of babies who are not breastfed. For example, a 2018 review analyzing the clinical experiences of infants fed HMO-supplemented formula found that such supplementation was "safe, well-tolerated, and absorbed and excreted" essentially as well as breastmilk.[14] Plus, these formula-fed infants also experienced the positive effects associated with HMOs: immune and digestive support.

13. Zhong, H., Penders, J., Shi, Z., Ren, H., Cai, K., Fang, C., Ding, Q., Thijs, C., Blaak, E. E., Stehouwer, C., Xu, X., Yang, H., Wang, J., Wang, J., Jonkers, D., Masclee, A., Brix, S., Li, J., Arts, I., & Kristiansen, K. (2019). Impact of early events and lifestyle on the gut microbiota and metabolic phenotypes in young school-age children. Microbiome, 7(1), 2. https://doi.org/10.1186/s40168-018-0608-z

14. Reverri, E. J., Devitt, A. A., Kajzer, J. A., Baggs, G. E., & Borschel, M. W. (2018). Review of the Clinical Experiences of Feeding Infants Formula Containing the Human Milk Oligosaccharide 2'-Fucosyllactose. Nutrients, 10(10), 1346. https://doi.org/10.3390/nu10101346

2'Fucosyllactose: A Notable HMO

2'Fucosyllactose (2'-FL) is a particularly beneficial HMO because it selectively feeds mutualistic bacteria, like the *bifidobacteria* we mentioned earlier.[15] A source of bacterial nourishment would render itself useless if it indiscriminately fed all bacteria in the gut, both "good" and "bad." Thus, HMOs like 2'-FL can act as beneficial prebiotics in the human digestive system for both infants and adults, evading digestion until they enter the lower GI tract to selectively feed *bifidobacteria*. After the transition from breastfeeding to a solid food diet, *bifidobacteria* populations tend to decline, making up just two to 14 percent of our total gut microorganisms in adulthood and an even lower fraction in elderly populations.[16]

15. Food for Beneficial Bacteria-2'-Fucosyllactose. (2020, November 19). Retrieved December 22, 2020, from https://wholisticmatters.com/food-for-beneficial-bacteria-2fl-a-human-milk-oligosaccharide/
16. Zhong, H., Penders, J., Shi, Z., Ren, H., Cai, K., Fang, C., Ding, Q., Thijs, C., Blaak, E. E., Stehouwer, C., Xu, X., Yang, H., Wang, J., Wang, J., Jonkers, D., Masclee, A., Brix, S., Li, J., Arts, I., & Kristiansen, K. (2019). Impact of early events and lifestyle on the gut microbiota and metabolic phenotypes in young school-age children. Microbiome, 7(1), 2. https://doi.org/10.1186/s40168-018-0608-z

The Relationship Between the Microbiome and Gut Health

Whether our individual microbiome has a positive or negative influence on our gut health and overall health largely depends on our specific composition of microorganisms in the microbiome. Different combinations of particular bacterial species are linked with positive and negative effects on our health.

Some positive effects of a healthy, diverse gut microbiome include:

- **Increased bioavailability of phytochemicals (plant metabolites associated with health benefits):**[17] Phytochemicals consumed in the diet are more likely to be absorbed into the bloodstream, distributed to tissues, and elicit positive health effects if they have increased bioavailability. Phenolic compounds are biologically transformed by gut microbiota, generating phenolic metabolites which may have different bioavailability in comparison to their parent compound. This means that these phenolic metabolites might be absorbed more rapidly or be more biologically active than phenolic compounds that were not transformed by gut microbiota.

- **Production of short-chain fatty acids (SCFA) like butyrate that provide energy for gut cells**

- **Interactions with bile acids, which play a role in digestion and absorption of nutrients**

- **Barrier protection from pathogenic microorganisms:** Maintaining intestinal integrity is important to prevent ingested pathogens from crossing into the bloodstream.

A diverse, balanced gut microbiome often represents balance in the gut's inflammatory responses. Positive alterations in the microbiome can lead to a myriad of healthy reactions for digestive health and more. Alternately, negative alterations in the gut microbiome, such as decreased microbiome diversity, is closely connected to chronic inflammation, insulin sensitivity, and glucose metabolism.

17. Ozdal, T., Sela, D. A., Xiao, J., Boyacioglu, D., Chen, F., & Capanoglu, E. (2016). The Reciprocal Interactions between Polyphenols and Gut Microbiota and Effects on Bioaccessibility. Nutrients, 8(2), 78. https://doi.org/10.3390/nu8020078

The Relationship Between the Microbiome and Immune System Strength

The immune system is a complex system of organs, tissues, and cells that protects the body from external threats. When the immune system is weak, we are more vulnerable to a variety of symptoms that can keep us from feeling our best. When the immune system is strong, we are more likely to thrive.

The microbiome supports the immune system in several key ways.

1. Mutualistic microbes compete with pathogenic microbes that could potentially colonize and overwhelm the immune system.

2. A healthy microbiome supports sturdy gut barrier integrity with strengthened tight junction proteins, providing protection in cases of GI distress.

3. Also in response to GI distress, mutualistic microbes promote the production of mucus and are involved in regulating gene expression related to the immune response.

Stress, inadequate sleep, poor eating habits, and natural aging can leave people more vulnerable and less equipped to overcome immune system challenges. By supporting the microbiome, we can also support a healthy immune system that can more easily stand up to those challenges.

Building the Human Microbiome

In reaction to changes in lifestyle, our individual ratio of mutualistic to pathogenic bacteria in the gut microbiome can ebb and flow, either creating or resolving health problems.

Additionally, chronic conditions can often cause a detrimental change in the composition of the microbiome.[18] With this in mind, making healthy lifestyle choices for the sake of fostering a healthy and diverse microbiome never loses its significance.

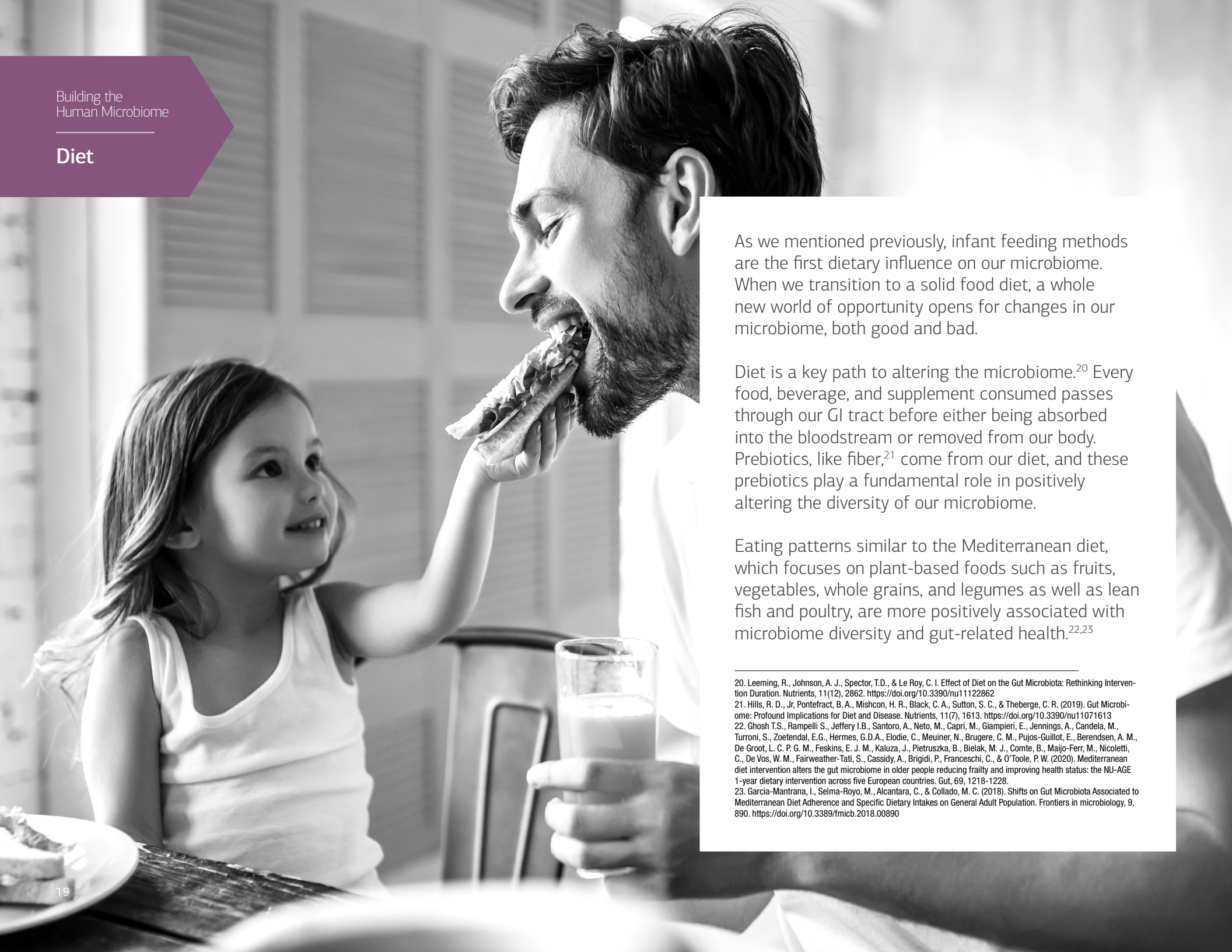
Beyond infancy, through childhood, adulthood, and old age, our microbiome composition and its volume changes in response to new and changing environmental exposures. There is no one healthy microbiome, and there is no finite recipe to create a healthy microbiome. Rather, a healthy human microbiome is an abstract result of our individual genetic makeup, environmental exposures, dietary habits, and other lifestyle factors,[19] including:

- Sleep habits and patterns
- Food choices
- Food consumption timing patterns
- Environmental exposure
- Physical activity habits
- Antibiotic use
- Stress
- Owning a pet
- Smoking habits

Let's dive into the major factors that influence the human microbiome: diet, environment, and lifestyle choices.

18. Arboleya, S., Watkins, C., Stanton, C., & Ross, R. P. (2016). Gut Bifidobacteria Populations in Human Health and Aging. Frontiers in microbiology, 7, 1204. https://doi.org/10.3389/fmicb.2016.01204
19. Impact of Nutrition on the Microbiome. (2019, November 19). Retrieved December 22, 2020, from https://wholisticmatters.com/impact-of-nutrition-on-the-microbiome/

Diet



As we mentioned previously, infant feeding methods are the first dietary influence on our microbiome. When we transition to a solid food diet, a whole new world of opportunity opens for changes in our microbiome, both good and bad.

Diet is a key path to altering the microbiome.[20] Every food, beverage, and supplement consumed passes through our GI tract before either being absorbed into the bloodstream or removed from our body. Prebiotics, like fiber,[21] come from our diet, and these prebiotics play a fundamental role in positively altering the diversity of our microbiome.

Eating patterns similar to the Mediterranean diet, which focuses on plant-based foods such as fruits, vegetables, whole grains, and legumes as well as lean fish and poultry, are more positively associated with microbiome diversity and gut-related health.[22,23]

20. Leeming, R., Johnson, A. J., Spector, T.D., & Le Roy, C. I. Effect of Diet on the Gut Microbiota: Rethinking Intervention Duration. Nutrients, 11(12), 2862. https://doi.org/10.3390/nu1122862
21. Hills, R. D., Jr, Pontefract, B. A., Mishcon, H. R., Black, C. A., Sutton, S. C., & Theberge, C. R. (2019). Gut Microbiome: Profound Implications for Diet and Disease. Nutrients, 11(7), 1613. https://doi.org/10.3390/nu11071613
22. Ghosh T.S., Rampelli S., Jeffery I.B., Santoro, A., Neto, M., Capri, M., Giampieri, E., Jennings, A., Candela, M., Turroni, S., Zoetendal, E.G., Hermes, G.D.A., Elodie, C., Meuiner, N., Brugere, C. M., Pujos-Guillot, E., Berendsen, A. M., De Groot, L. C. P. G. M., Feskins, E. J. M., Kaluza, J., Pietruszka, B., Bielak, M. J., Comte, B., Maijo-Ferr, M., Nicoletti, C., De Vos, W. M., Fairweather-Tati, S., Cassidy, A., Brigidi, P., Franceschi, C., & O'Toole, P. W. (2020). Mediterranean diet intervention alters the gut microbiome in older people reducing frailty and improving health status: the NU-AGE 1-year dietary intervention across five European countries. Gut, 69, 1218-1228.
23. Garcia-Mantrana, I., Selma-Royo, M., Alcantara, C., & Collado, M. C. (2018). Shifts on Gut Microbiota Associated to Mediterranean Diet Adherence and Specific Dietary Intakes on General Adult Population. Frontiers in microbiology, 9, 890. https://doi.org/10.3389/fmicb.2018.00890

Environment

We mentioned previously that a newborn's delivery method is the first major environmental influence on the composition of the microbiome. But after delivery, a lifetime of environmental exposure factors awaits. Our microbiome is also influenced by geographical location, such as urban versus rural living environments, and differing environmental influences in various states, countries, and continents.

Other Lifestyle Factors

Stress is another lifestyle factor that influences the composition of our microbiome, but the composition of our microbiome also influences the way an individual manages stress. Bacteria in the microbiome can communicate with the brain through the enteric nervous system, sending signals through the vagus nerve. In this way, the microbiome influences the stress response of the hypothalamic-pituitary-adrenal (HPA) axis and impacts memory, mood, and cognition.[24]

24. Gur, T. L., Worly, B. L., & Bailey, M. T. (2015). Stress and the commensal microbiota: importance in parturition and infant neurodevelopment. Frontiers in psychiatry, 6, 5. https://doi.org/10.3389/fpsyt.2015.00005

What Makes an Unhealthy Human Microbiome

Certain lifestyle choices may have a particularly negative influence on the composition of the microbiome.

Processed Foods

Our microbiome largely reflects our dietary choices. The Standard American Diet (SAD) — which is inundated with processed foods and largely deficient in whole foods such as fruits, vegetables, and whole grains — is negatively associated with microbiome health and other gut health factors. Common foods in the SAD may feed too many pathogenic gut bacteria and too few mutualistic gut bacteria. The SAD is often high in fat and refined sugar and low in fiber. This combination is detrimental to microbiome diversity and is frequently associated with GI inflammation.[23,25,26]

23., 25. Garcia-Mantrana, I., Selma-Royo, M., Alcantara, C., & Collado, M. C. (2018). Shifts on Gut Microbiota Associated to Mediterranean Diet Adherence and Specific Dietary Intakes on General Adult Population. Frontiers in microbiology, 9, 890. https://doi.org/10.3389/fmicb.2018.00890
26. Zinöcker, M. K., & Lindseth, I. A. (2018). The Western Diet-Microbiome-Host Interaction and Its Role in Metabolic Disease. Nutrients, 10(3), 365. https://doi.org/10.3390/nu10030365

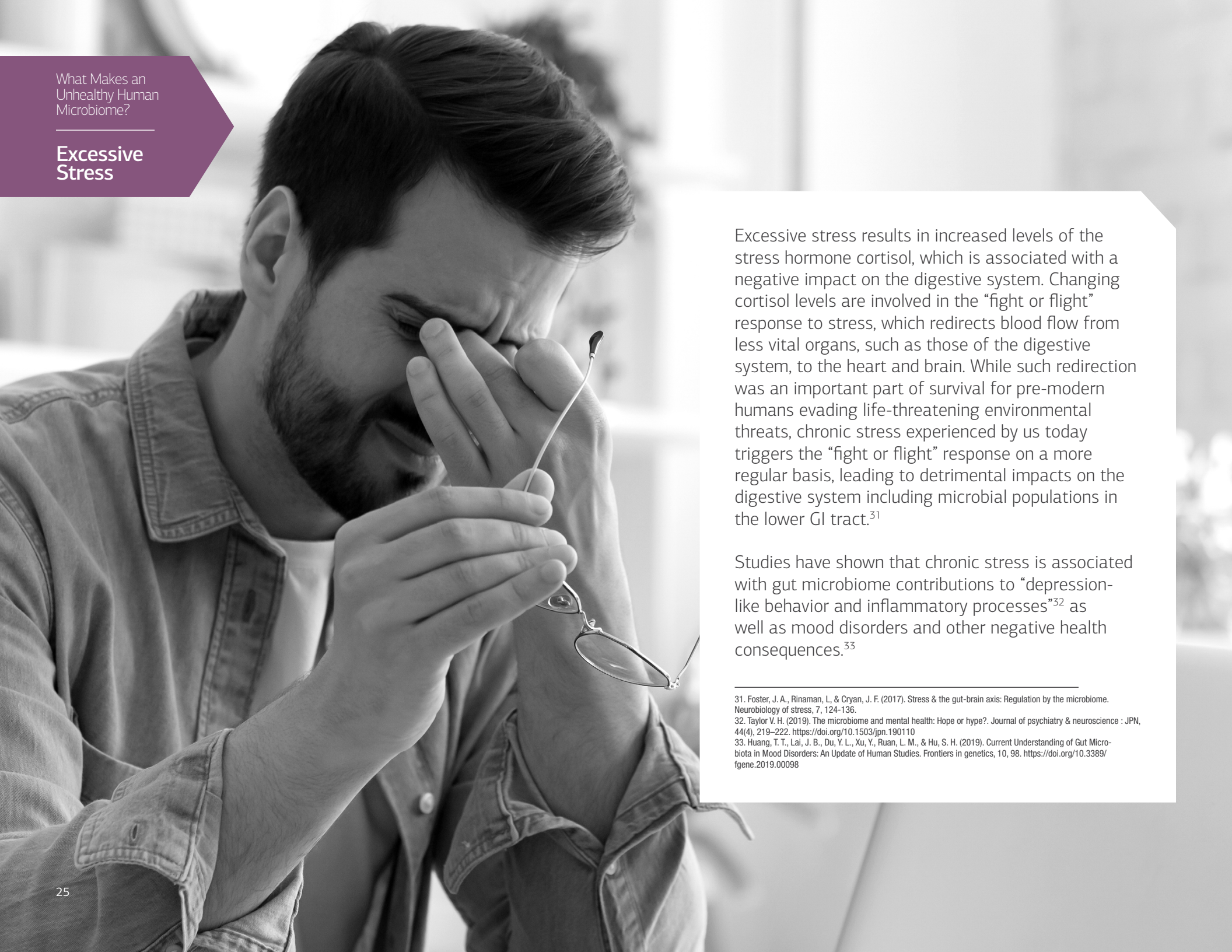
Antibiotics Misuse

While antibiotics are necessary to counter deleterious bacterial infections, overusing antibiotics may kill mutualistic bacteria in the gut in addition to squashing the intended bacterial infection.[27] Misusing antibiotics entirely is also harmful to the microbiome, such as in a case where antibiotics have been prescribed for an unknown infection that could actually be stemming from a viral invasion. Antibiotics will have no effect on a viral infection, and any positive experience of recuperation after taking antibiotics is often conflated with the body's natural anti-viral immune response. Antibiotic overuse and misuse is associated with long-term health consequences, such as reduced integrity of the GI tract lining, resulting in intestinal hyperpermeability,[28] or "leaky gut."[29,30]

Studies in mice have found that antibiotic exposure, by disrupting the development of the early-life microbiome, which often causes loss of species and strain diversity (i.e., biodiversity loss), leads to metabolic perturbations that affect adiposity and bone growth and alter normal immunologic development.

27. Klasco, R. (2018, December 21). Does the Gut Microbiome Ever Fully Recover From Antibiotics? Retrieved December 22, 2020, from https://www.nytimes.com/2018/12/21/well/live/does-the-gut-microbiome-ever-fully-recover-from-antibiotics.html
28. Cully, M. (2019, June 17). Antibiotics alter the gut microbiome and host health. Retrieved December 22, 2020, from https://www.nature.com/articles/d42859-019-00019-x
29. Cho, I., Yamanishi, S., Cox, L., Methé, B.A., Zavadil, J., Li, K., Gao, Z., Mahana, D., Raju, K., Teitler, I., Li, H., Alekseyenko, A.V., & Blaser, M.J. (2012). Antibiotics in early life alter the murine colonic microbiome and adiposity. Nature, 488, 621–626.
30. Cox, L. M., Yamanishi, S., Sohn, J., Alekseyenko, A. V., Leung, J. M., Cho, I., Kim, S. G., Li, H., Gao, Z., Mahana, D., Zárate Rodriguez, J. G., Rogers, A. B., Robine, N., Loke, P., & Blaser, M. J. (2014). Altering the intestinal microbiota during a critical developmental window has lasting metabolic consequences. Cell, 158(4), 705–721. https://doi.org/10.1016/j.cell.2014.05.052

Excessive Stress



Excessive stress results in increased levels of the stress hormone cortisol, which is associated with a negative impact on the digestive system. Changing cortisol levels are involved in the "fight or flight" response to stress, which redirects blood flow from less vital organs, such as those of the digestive system, to the heart and brain. While such redirection was an important part of survival for pre-modern humans evading life-threatening environmental threats, chronic stress experienced by us today triggers the "fight or flight" response on a more regular basis, leading to detrimental impacts on the digestive system including microbial populations in the lower GI tract.[31]

Studies have shown that chronic stress is associated with gut microbiome contributions to "depression-like behavior and inflammatory processes"[32] as well as mood disorders and other negative health consequences.[33]

31. Foster, J. A., Rinaman, L, & Cryan, J. F. (2017). Stress & the gut-brain axis: Regulation by the microbiome. Neurobiology of stress, 7, 124-136.
32. Taylor V. H. (2019). The microbiome and mental health: Hope or hype?. Journal of psychiatry & neuroscience : JPN, 44(4), 219–222. https://doi.org/10.1503/jpn.190110
33. Huang, T. T., Lai, J. B., Du, Y. L., Xu, Y., Ruan, L. M., & Hu, S. H. (2019). Current Understanding of Gut Microbiota in Mood Disorders: An Update of Human Studies. Frontiers in genetics, 10, 98. https://doi.org/10.3389/fgene.2019.00098

What Makes a Healthy Human Microbiome?

While a healthy microbiome will look different for different individuals, a healthy microbiome will include these four attributes:

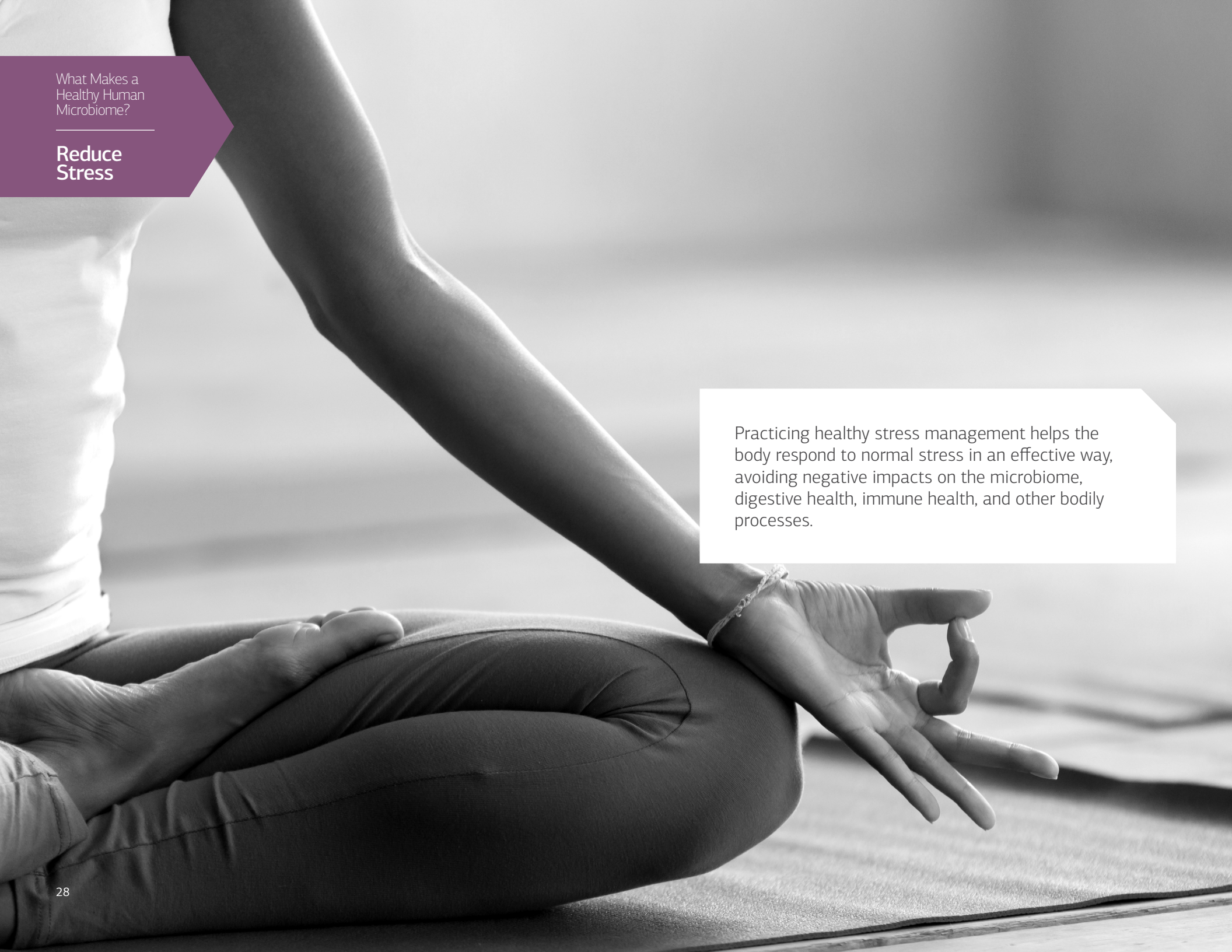
1. A balance of different microbial species
2. Balance of the right amount of microorganisms
3. Minimal harmful strains of bacteria
4. Maximum beneficial strains of bacteria

The following tips can help cultivate a healthy microbiome.

Eating a Healthy Diet

A diet that supports a healthy microbiome contains a lot of vegetables, fruits, whole grains, nuts, seeds, lean protein, and fermented foods. Limit processed food intake, minimize sugar intake, and choose healthy fats over unhealthy fats.

Reduce Stress



Practicing healthy stress management helps the body respond to normal stress in an effective way, avoiding negative impacts on the microbiome, digestive health, immune health, and other bodily processes.

Eliminate Toxins

We are constantly exposed to toxins and toxicants endogenously and from the external environment. Supporting the body's natural detoxification process may limit the damage toxin exposure can have on the microbiome. For example, in addition to supporting digestion and the microbiome, fiber consumption improves bowel movements and may facilitate toxin elimination in the third phase of the body's natural detoxification process.

Improve Diversity

We can improve our microbiomes by adjusting our lifestyle habits where needed to increase diversity of the microbiome. Choose other healthy lifestyle habits like frequent exercise, smoking cessation, taking antibiotics only when necessary and as directed, adequate hydration, and healthy sleep habits to maximize your microbiome's potential to flourish.

Supplements

When additional support is needed to enhance lifestyle changes, prebiotics and probiotics in the form of whole food-based nutritional supplements can help improve the microbiome. Prebiotic and probiotic supplements provide the microbiome with the nourishment and living support it needs to build healthy, thriving populations of mutualistic bacteria. Looks for supplements that are:

- High in whole food ingredients
- Low in overly processed ingredients that remove the nutrients
- Scientifically backed to improve microbiome health

A healthy microbiome is an important part of a healthy body. It plays a role in a number of vital functions — from gut health to immune system strength, and more. Though a number of factors can challenge the microbiome, there are also plenty of ways for humans to support this critical system.

Learn more at standardprocess.com/microbiome-supplements.

*These statements have not been evaluated by the Food and Drug Administration. These products are not intended to diagnose, treat, cure, or prevent any disease.

Standard Process®

WHOLE FOOD NUTRIENT SOLUTIONS