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Title of essay: The Human Microbiome

In this essay we will be discussing about the human microbiome.

Firstly, what is a microbe? A microbe, or “microscopic organism,” is a living thing that is too small to be seen with the naked eye. We need to use a microscope to see them. The term ‘microbe’ is used to describe many different types of life forms with dramatically different sizes and characteristics. Examples of microbes include bacteria, fungi, protists, viruses and microscopic animals that live in humans. The ratio of microbes to our human cells in our body is approximately 10:1.

Microbiome refers to the full collection of genes of all the microbes in a community. The human microbiome can be considered a counterpart to the human genome. The genes in our microbiome outnumber the genes in our genome by about 200 to 1.

Although many microbes can gain access to an ecosystem, only those with the proper adaptations to use the available resources and withstand environmental challenges can survive and reproduce. This coincides with the idea of “survival of the fittest”, a quote from the Darwinian Evolutionary Theory.

Before birth, we have no microbes. In the womb, babies are protected from microbes which are harmful to them by the amniotic sac. The moment we enter the world, we're colonized by different types of microbes. Our first dose of microbes comes from our mother. Babies delivered vaginally are covered in a film of microbes as they pass through the birth canal which contains bacteria such as *Lactobacillus*. The bacteria get on the baby’s skin and in its mouth. When the baby swallows, that helpful bacteria goes right to its digestive system, kickstarting its microbiome.

Autoimmune diseases appear to be passed in families not by DNA inheritance but by inheriting the family's microbiome.

Obese people have more bacteria of a group called *Firmicutes* and fewer *Bacteroidetes* bacteria than lean people. *Firmicutes* bacteria are the types of microbes that harvest energy from food and help the body store fat. This can set the stage for weight gain. Giving obese people more of *Bacteroidetes* bacteria such as *Akkermansia muciniphila* from the gut helped them lose some pounds and restored the protective mucus layer in their intestines.

We have vastly different populations of microbes living in different parts of the body. Having microbes in our body gives us many benefits such as help digest our food, produce certain vitamins, regulate our immune system, and keep us healthy by protecting us against disease-causing bacteria.

Microbes in our intestines break down food that we cannot digest on our own. Carbohydrates-busting microbes increases the value of our food by increasing the nutrients that we could absorb by 10%. Otherwise, more undigested food would be defecated.

Microbes in large intestine make vitamins that we cannot make on our own. B-vitamins are important co-enzymes used in the synthesis of DNA and repair to both our cells and bacteria. They also take part in the building of amino acids and in harvesting energy from fats and proteins which is the basic metabolic function we shared with microbes.

By making our bodies a comfortable place for microbes to live, we can benefit from their vitamin-building genes, and even extend their

usefulness. For example, we use vitamin k to help our blood clot. B12 which can only be made by bacteria and archaea to help build healthy blood and brain tissues. Other microbe-produced vitamin help to regulate blood sugar, strengthen the immune system and keep nervous system function properly.

Eating a fibre rich diet will help your microbiome to grow and contain a diversity of different organisms, whereas eating lots of processed foods, and foods high in refined carbohydrates or saturated fats will upset the balance and allow unhealthy bacteria to take over.

Antibiotics, alcohol and stress also wipe out good bacteria and allow the undesirables to predominate.

Many microbes release molecules that keeps completing bacteria and fungi away. Healthy microbes also helps the body to defend itself. Example the *S. epidermis* bacteria on our skin, will signal our cells and promoting us to produce microbe-fighting that protect us from infections.

Last but not least, microbes keeps our skin supple. Microbes converts skin oil into natural moisturizers that keeps skin soft, flexible and crack-free. A healthy crack-free skin is a strong barrier that keeps out bacteria and other harmful things.

Therefore the microbiome is necessary for human development, immunity and nutrition. The bacteria living in and on us are not invaders but beneficial colonizers.

However, dysfunctioning of the microbial ecosystem can lead to autoimmune diseases such as Acne , Antibiotic-associated diarrhea, Asthma/allergies , autism , cancer , dental cavities ,depression and anxiety , diabetes , gastric ulcer , malnutrition and also obesity.

Disease-causing microbes accumulate over time, changing gene activity and metabolic processes and result in an abnormal immune response against substances and tissues normally present in the body. Acne may not be particularly dangerous, but it is certainly both unpleasant and very common. Acne typically happens with P. acnes, a type of bacteria that also lives on healthy skin, invades hair follicles, causing irritation and infection.

In severe cases, acne is treated with antibiotics. Some of these drugs are applied directly to the skin, and others are taken as a pill. Delivered in pill form, antibiotics travel throughout the entire body, where they can also kill beneficial microbes. Some doctors are beginning to wonder if treating acne this way makes us vulnerable to other illnesses. At the root of acne seems to be an imbalance between acne-causing bacteria and microbes that protect us.

Gastric ulcers are painful sores inside the stomach or the first part of the small intestine. A healthy digestive tract has a protective layer of mucus, but ulcers are open to attack from the stomach acids that help digest our food. In the early 1980s, doctors discovered that the vast majority of gastric ulcers around 80% are associated with *Helicobacter pylori* bacteria. To treat severe ulcers, patients are often given mixtures of two to three different types of antibiotics.

H. pylori lives in about half of all healthy people as well, and most of these people don't develop ulcers. We don't understand why some people are more susceptible, but it looks like diet plays a role. Eating different types of food changes the abiotic factors of the stomach, making conditions more or less hospitable to different types of bacteria.

Interestingly, *H. pylori* may also be important for developing a healthy immune system. People who have antibodies against *H. pylori*, showing that they have been exposed to this bug at some point in their lives, are less likely than others to develop asthma. And those that do develop asthma tend to do so at a later age.

There is some evidence that microbes may have an indirect role in cancer. For example, some microbes cause inflammation, which appears to increase cancer risk.

A number of microbes also have more direct connections to cancer. *H. pylori* bacteria, a common cause of stomach ulcers, is also associated with cancers of the stomach and esophagus. A number of viruses cause cancer as well: *Hepatitis B and C* greatly increase the risk of liver cancer; the sexually transmitted HPV (human papilloma virus) is associated with many cervical cancers; and EBV (Epstein-Barr virus, the cause of mononucleosis) is associated with *lymphomas* (cancerous white blood cells) and other cancers.

The Human Microbiome Project (HMP) A strategy to understand the microbial components of the human genetic and metabolic landscape and how they contribute to normal physiology and predisposition to disease.

One of the main goals of the HMP is to understand the range of human genetic and physiological diversity, the microbiome and the factors that influence the distribution and evolution of the constituent microorganisms need to be characterized. The outcome might also provide perspective on contemporary human evolution: that is, on whether and how rapidly advancing technology, and the resultant transformation of human lifestyles and the biosphere, influences the 'micro-evolution' of humans and thereby health and predisposition to various diseases.

The HMP sponsored by the National Human Genome Research Institute (NHGRI), part of the National Institutes of Health (NIH). The HMP began in 2008, it is a logical conceptual and experimental extension of the Human Genome Project. And is a 5-year feasibility study with a budget of $150 million, it is being carried out in a number of centers around the US. The HMP serves as a roadmap for discovering the role of the microbiome in health, nutrition, immunity, and disease.

The first stage of the Human Microbiome Project sampled 300 healthy people to determine normal microbial composition of healthy people, their biochemical function, and microbial variation both between individuals and over time. Now that we have determined the healthy human microbiome, the next stage of the Human Microbiome Project is to understand how the microbiome changes in and contributes toward disease.

For example, Inflammatory bowel disease (IBD), which includes both Crohn's Disease (CD) and ulcerative colitis (UC), is due to the imbalances between microbes and the immune system. A comprehensive body of evidence has linked IBD to the gut microbiota , many studies have found an association between IBD and an overall disrupted gut ecology and decrease

in diversity. The Inflammatory Bowel Disease Multi'omics Database (IBDMDB) will provide an integrated resource for analyzing the gut microbial ecosystem in the context of IBD, improving our ability to understand, diagnose, and treat IBD.

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