



## Myths Regarding Microbiome Research

**For Prelims:** Myths Regarding Microbiome Research, Microorganisms, Firmicutes and Bacteroidetes, Phylum.

**For Mains:** Myths Regarding Microbiome Research, Microbiome's Link with bodily functions, Science and Technology- Developments and their Applications and Effects in Everyday Life. Awareness in the fields of Nano-technology, Bio-technology.

[Source: TH](#)

### Why in News?

In the last two decades, Microbiome Research has gone from a **'Niche subject area'** to **'one of the hottest topics'** in all of science'.

- Microbial interactions and activities within the human gut have been a subject of extensive research and discussion.
- Contrary to popular misconceptions, recent assessments shed light on the complexity of the human microbiome, challenging certain widely believed claims.

### Note

- Under the Union Budget 2021-22, the government outlaid Rs. 1,660 crore for biotechnology research and development.

### What is Microbiome?

- **About:**
  - The **microbiome is the community of [Microorganisms](#)** (such as fungi, bacteria and viruses) that exists in a **particular environment**.
  - In humans, the term is often used to describe the microorganisms that live in or on a particular part of the body, such as the skin or gastrointestinal tract.
  - These groups of microorganisms are **dynamic and change in response to a host of environmental factors**, such as exercise, diet, medication and other exposures.
- **Myths Regarding Microbiome in Human Body:**
  - **The Age of the Field:**
    - One of the misconceptions is that Microbiome Research is a new field. Scientists had described and **speculated on the benefits of bacteria inhabiting the gut**, such as *Escherichia coli* and *Bifidobacteria*, as early as the **late 19<sup>th</sup> and early 20<sup>th</sup> centuries itself**.
  - **The Question of Origin:**

- The term "microbiome" in its modern form was used before its popularization in 2001, challenging the common attribution to Joshua Lederberg.
  - Joshua Lederberg is a **Nobel laureate in medicine**, with the naming of the field in 2001.
- The term had been used in 1988 to describe a community of microbes.
- **The Number and Mass of Microbes:**
  - Some of the more prevalent and more harmful myths **concern the size of the microbiome.**
    - The actual number of microbial cells in human feces is around  $10^{10}$  to  $10^{12}$  per gram, and the **weight of the human microbiota is about 200 grams**, not 1-2 kg as often stated.
- **From Mother to Child:**
  - Contrary to some opinions, mothers don't pass their microbiomes to their children at birth.
  - Some **microorganisms are directly transferred during birth** but they constitute a small fraction of the human microbiota; and only an even smaller fraction of these microbes survive and persist throughout the child's life.
  - Every adult ends up with a unique microbiota configuration, even identical twins that are raised in the same household.
- **Microbes are Dangerous:**
  - Some researchers have suggested that diseases are caused by undesirable interactions **between microbial communities and our cells.**
  - But whether a microbe and its metabolite are 'good' or 'bad' depends on the context.
    - For example, **most humans carry a species of bacteria called *Clostridium difficile*** without any disease for life. It causes **problems only in the elderly or in people with compromised immune systems.**
- **The Firmicutes-Bacteroidetes Ratio:**
  - One myth correlates obesity with the **ratio of two phyla of bacteria** — Firmicutes and Bacteroidetes.
  - The problem with this myth is that the level of phyla is too broad to comment on effects with confidence.
    - A phylum is a group within a kingdom. In the descending order of classifying organisms, **a kingdom comprises different phyla; a phylum comprises classes; then there are orders, families, genera, and, finally, species.**
    - Even within a bacterial species, several strains behave differently, causing the host to manifest different clinical symptoms.
- **Functionality and Redundancy of Microbes:**
  - Not all microbes are functionally redundant; many functions are **specific to certain species within** the microbiome.
  - Some researchers have claimed that different microbes are actually functionally redundant.
  - However, the different bacteria in the human microbiome perform some common important functions, many functions are the preserve of a few species.
- **Bias in Sequencing:**
  - Sequencing in microbiome research is not entirely unbiased; **biases can be introduced at various stages**, affecting the results and conclusions.
- **Standardized Methods in Microbiome Research:**
  - While standardized methods are important for comparing findings across studies, no methodology is perfect, and it is crucial to acknowledge the limitations of the chosen method.
- **Culturing the Microbiome:**
  - While it's challenging to grow microbes from the human microbiome in the lab, there have been successful efforts in the past, indicating that current gaps in culture collections are due to a lack of previous effort rather than inherent 'unculturability'.

## How the Human Microbiome is Linked with Bodily Functions?

- **Digestive Health and Nutrient Absorption:**
  - The gut microbiome, primarily in the intestines, aids in breaking down complex carbohydrates, fibers, and other indigestible compounds that the human body can't process on its own.
  - Microbes assist in the fermentation process, producing essential nutrients such as vitamins (e.g., Vitamin B and K) that the body can absorb and utilize.
- **Immune System Regulation:**
  - The microbiome interacts closely with the immune system, influencing its development, training, and responses.
  - A well-balanced microbiome helps regulate immune responses, preventing inappropriate reactions and enhancing the ability to fight off infections.
- **Metabolic Health and Weight Regulation:**
  - The composition of the gut microbiome has been linked to metabolic disorders like obesity and type 2 diabetes.
  - Certain microbes may affect metabolism, energy extraction from food, and storage of fats, ultimately impacting body weight and metabolic health.
- **Mental Health and Brain Function:**
  - The **gut-brain axis represents the bidirectional communication between the gut and the brain** through neural, hormonal, and immunological pathways.
  - The gut microbiome can influence brain function, behavior, and mental health conditions such as anxiety, depression, and stress by producing neurotransmitters and interacting with the central nervous system.

## UPSC Civil Services Examination Previous Year Question (PYQ)

### **Mains**

**Q.** What are the research and developmental achievements in applied biotechnology? How will these achievements help to uplift the poorer sections of the society? **(2021)**

**Q.** How can biotechnology help to improve the living standards of farmers? **(2019)**