

# Cannabis and Health

Module 13: Inflammation and the Microbiome

Lecture 1: Overview of Inflammation and the  
Microbiota Gut Brain Axis

# Some Definitions...

- Immunology is the study of the physiological mechanisms that humans and other animals use to protect/defend their bodies from pathogens or injury
- An immune response is the reaction of cells and fluids of the body to the presence of a substance which is not recognized as a constituent of the body itself

# Innate vs. Adaptive Immunity

- **Adaptive immunity** refers to antigen-specific **immune** response.
  - When an antigen has been recognized, the **adaptive immune** system creates an army of **immune** cells specifically designed to attack that antigen.
  - Adaptive is “learned” or “immune memory” - think chickenpox vaccine
- **Innate immunity** refers to the cells and mechanisms that provide the first line of defense from infection in a non-specific manner.
  - **Innate immune** responses are rapid and independent of antigen
  - When you get a cut , your body reacts by sending immune molecules to the site of infection to protect you
  - We will mainly be focused on the innate immune system

# Cytokines and inflammation

- Cytokines are the main way of measuring inflammation in humans
- All immune cells produce cytokines
  - Pro-inflammatory cytokines ramp up immune system activity
  - Anti inflammatory downregulates immune activity
- Cytokines regulate immunological responses, and cell-to-cell communication as well as host responses to infectious agents and inflammatory stimuli
- They interact with each other in complex ways that may be additive, synergistic or antagonistic, or may involve the induction of one cytokine by another.

# What is the Microbiota Gut Brain Axis?

- The gut brain axis (MGBA) consists of bidirectional communication between the gastrointestinal tract, endocrine, autonomic, enteric, immune and central nervous systems
- The quantity and composition of gut microbial species inhabiting the gastrointestinal tract (known as the “gut microbiome”) is critical
- The immune system is fundamental to gut-brain communication
- Accumulating evidence suggests bidirectional communication between the gut microbiota, brain and immune systems.
  - For example, gut microbiota impacts circulating inflammatory signaling molecules such as cytokines, which in turn impact brain function

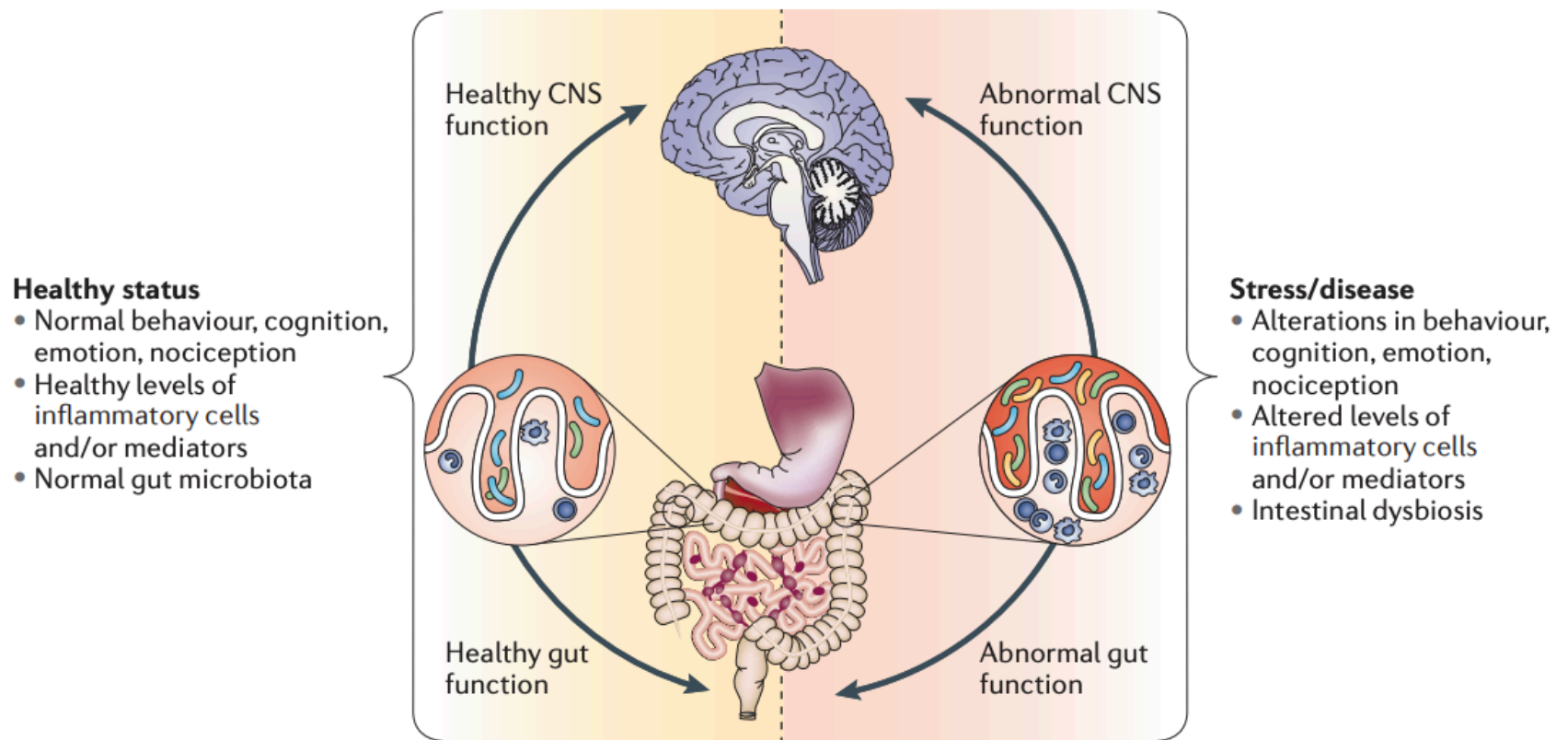
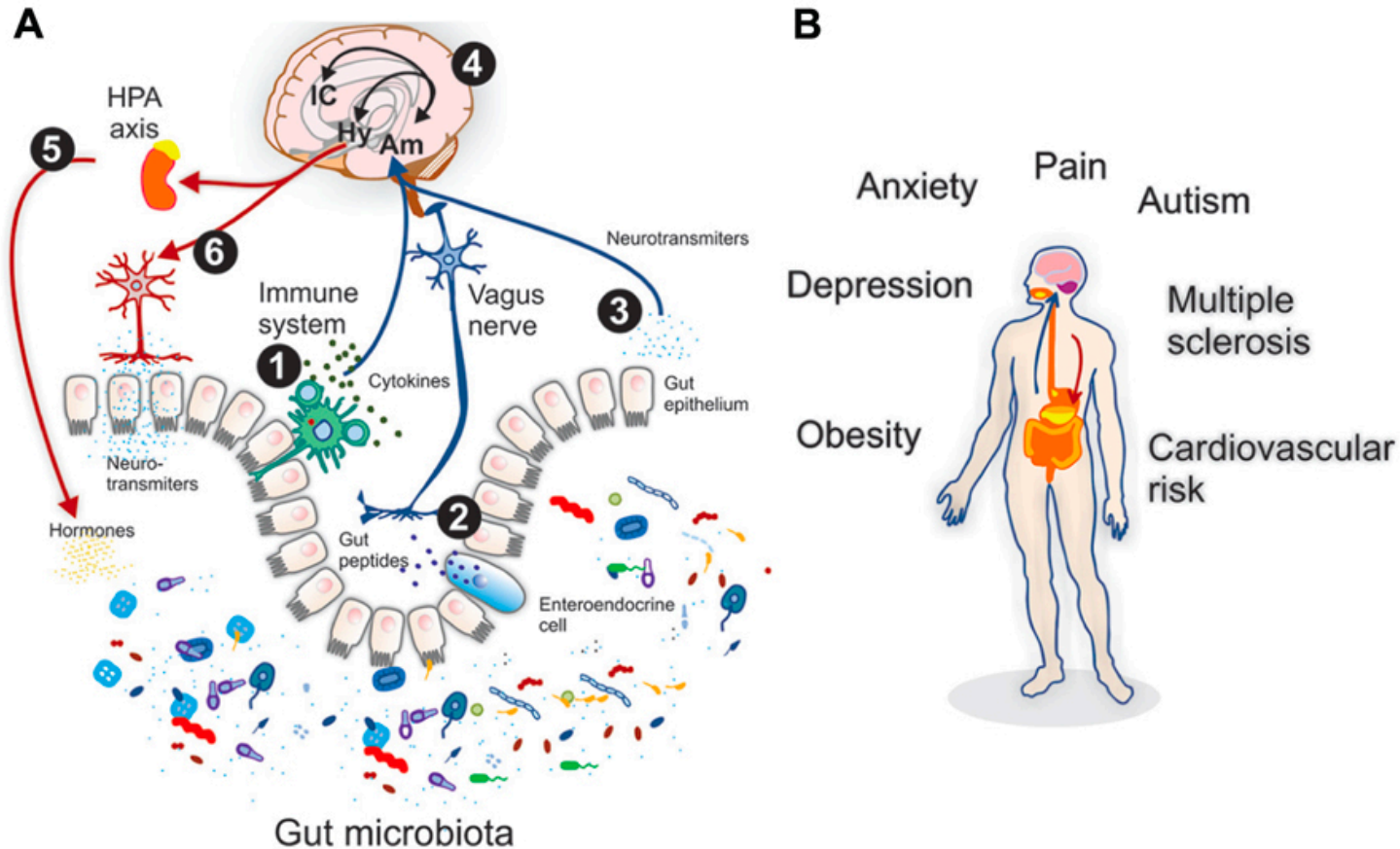
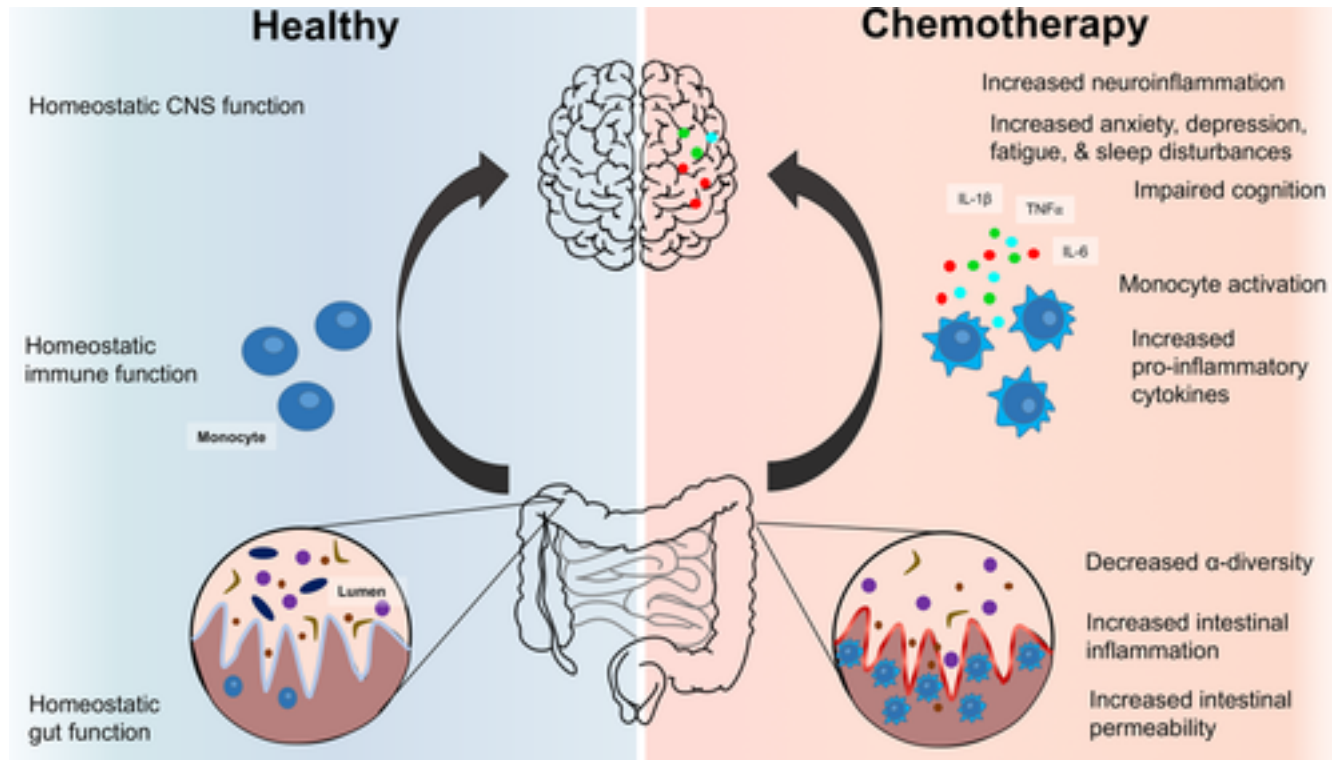


Figure 3 | **Impact of the gut microbiota on the gut–brain axis in health and disease.** It is now generally accepted that a stable gut microbiota is essential for normal gut physiology and contributes to appropriate signalling along the gut–brain axis and, thereby, to the healthy status of the individual, as shown on the left-hand side of the figure. As shown on the right-hand side of the figure, intestinal dysbiosis can adversely influence gut physiology, leading to inappropriate gut–brain axis signalling and associated consequences for CNS functions and resulting in disease states. Conversely, stress at the level of the CNS can affect gut function and lead to perturbations of the microbiota. Figure is modified from REF. 23.

# Microbiota Gut Brain Axis



# Gut-Immune Interaction: An Example



Gut microbiota-immune-brain interactions in chemotherapy-associated behavioral comorbidities



# Summary

- The immune system, in particular innate immunity, plays a critical role in terms of defending the body and as a result produces inflammation
- Part of the inflammatory response is the secretion of pro and anti-inflammatory cytokines which produce a variety of effects in the brain and body
- The state of the gut microbiome is also an important player in terms of activity of the immune system and inflammation
- Changes in inflammation and the microbiome may be an important mechanism for a variety of disease states