

ABSTRACT

An estimated 31% of adults in the U.S have suffered from anxiety in their lifetime. Anxiety is a mental health condition that affects people in many ways, and can be a precursor of health conditions like depression. The focus of this literature review is to analyze the function of different gut microbiota and their effects on anxiety. Recent evidence indicates D-alanine, an amino acid found in bacterial cell walls within the intestinal microbiome, influences how an individual reacts to negative emotions. Therefore, this review seeks to uncover the specific relationship between gut microbiota and anxiety through looking at how specific types of bacteria affect anxiety levels. Recent studies have shown that total lack of a gut microbiota in mice resulted in higher levels of a neurotransmitter called serotonin (5HT) in the gastrointestinal tract from the microbiota in the gastrointestinal system. Furthermore, an excess amount of serotonin in the nervous system can cause stress related symptoms such as irritability and restlessness. In addition, findings demonstrate that adults with irritable bowel syndrome (IBS) have higher anxiety levels suggesting that the brain-gut pathway is bi-directional. Despite knowing that gut dysfunction like IBA and total lack of gut microbiota can lead to increased anxiety, it remains unclear how the gut microbiota's neurotransmitters communicate with the brain to impact anxiety. Future research should focus on uncovering the mechanisms of this brain to gut connection.

METHODS

To evaluate the relationship between gut microbiota and anxiety, we conducted a literature review of 26 studies from multiple journals such as Journal of psychosomatic research, journal of microbiology.

References



BACKGROUND

Stress Response and Development of Allostatic Load

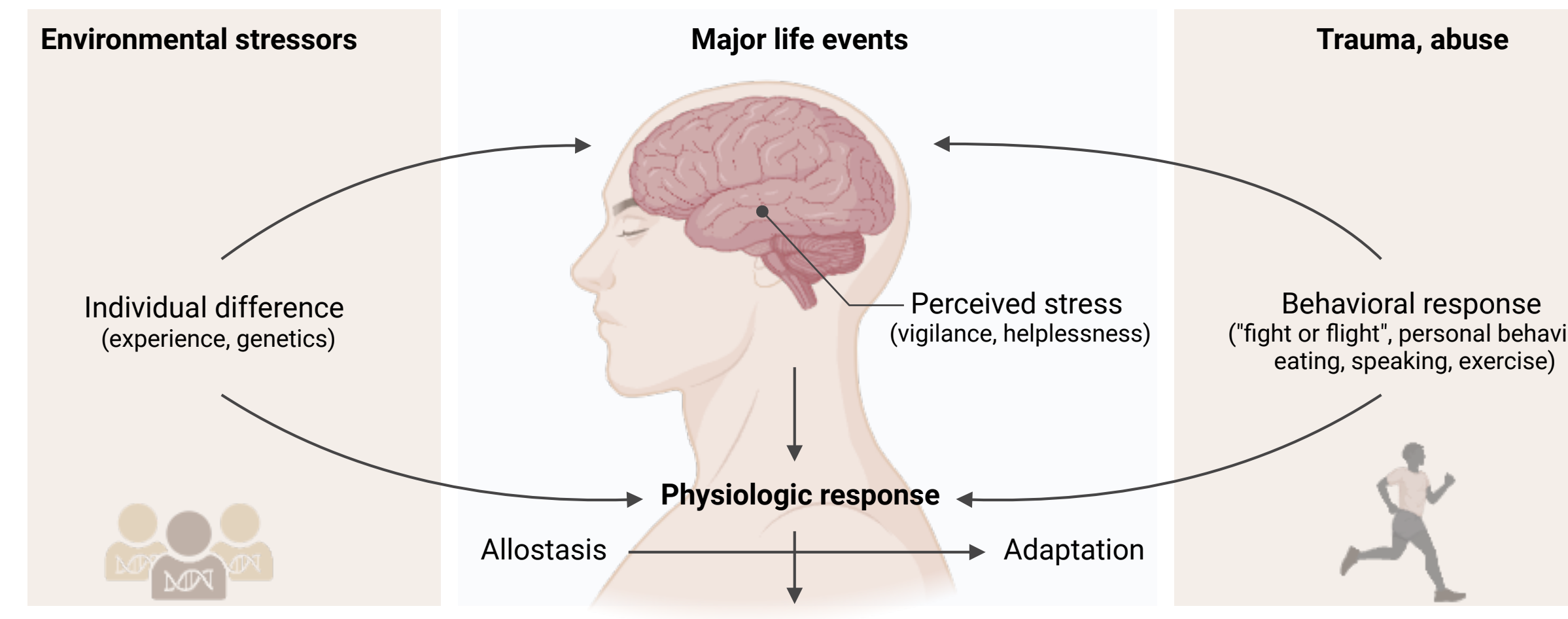


Fig 4. Stress Response and Development of Allostatic Load due to trauma, abuse and other major life events. The development of anxiety can be influenced by many factors, such as traumatic events and living in a stressful environment throughout childhood (IMcLaughlin 2010),

- Anxiety can develop from many different factors such as traumatic events and living in a stressful environment throughout childhood called Allostatic load.
- The overall role of the gut-brain axis is the communication between the gastrointestinal system and the central nervous system
- The gut microbiome plays a huge role in the amount of serotonin present
- Therefore in order to find the relationship between the gut microbiome and anxiety, we looked into the specific neurotransmitters that help with mood regulation

INTRODUCTION

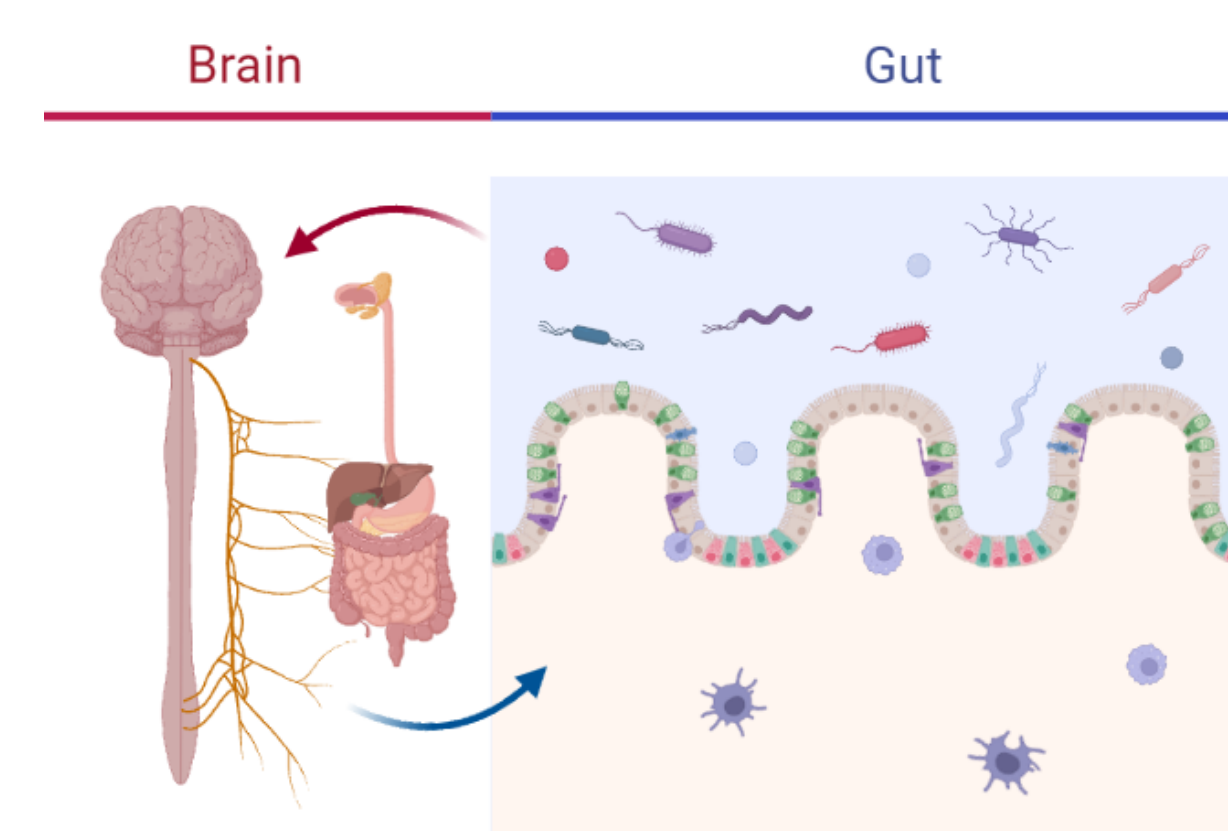


Fig 1. General pathway showing the Brain and gut microbiome.(Nuss 2015),

- A recent study has found that an imbalance in the gut can lead to a decrease in brain function causing anxiety.
- Looking into the imbalance in neurotransmitters like cortisol and serotonin is where research began

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RESULTS

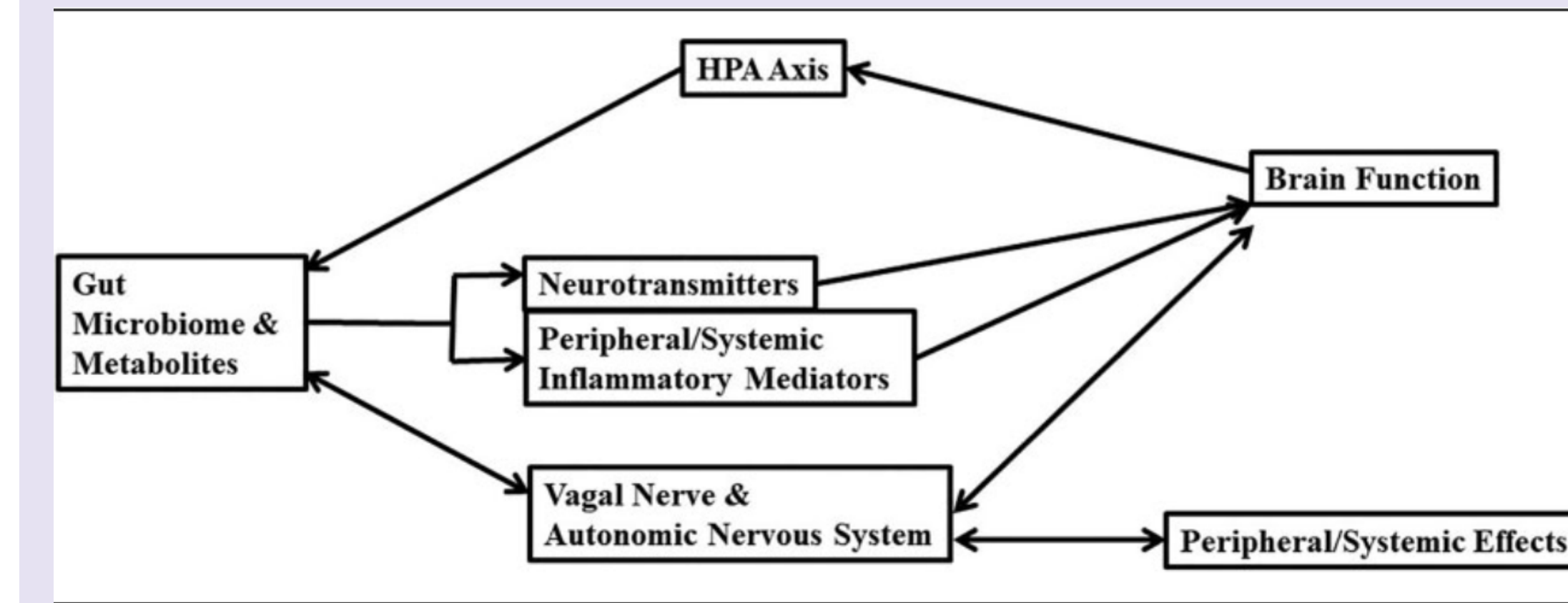


Fig 5. The hypothesized hypothalamic-pituitary-adrenal-axis. (Wen Gao 2020)

- Recent studies have shown that mice that lack a microbiota had higher levels of serotonin, which plays a role in responding to stress in the gastrointestinal tract.
- In the bar graph below there was a p value <.05 showing that the absence of the microbiota affects the response to acute stress in a sex-dependent manner.
- Furthermore, recent studies have indicated the direct relationship between gastrointestinal disorder like IBS with increased anxiety like symptoms

Comparing Microbiomes of Mice

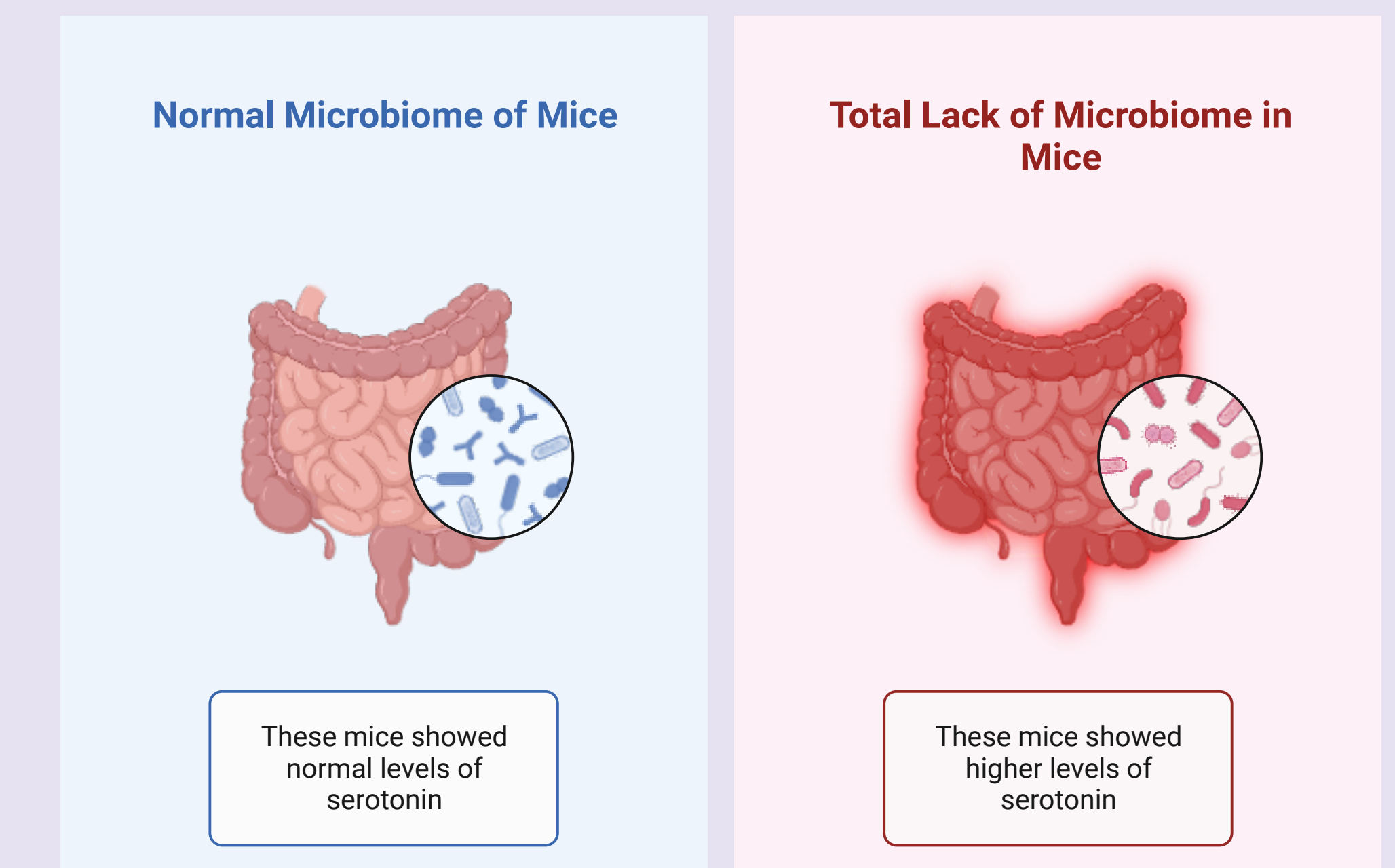


Fig 3. Comparing the normal and abnormal microbiomes in mice. (Lyte 2020),

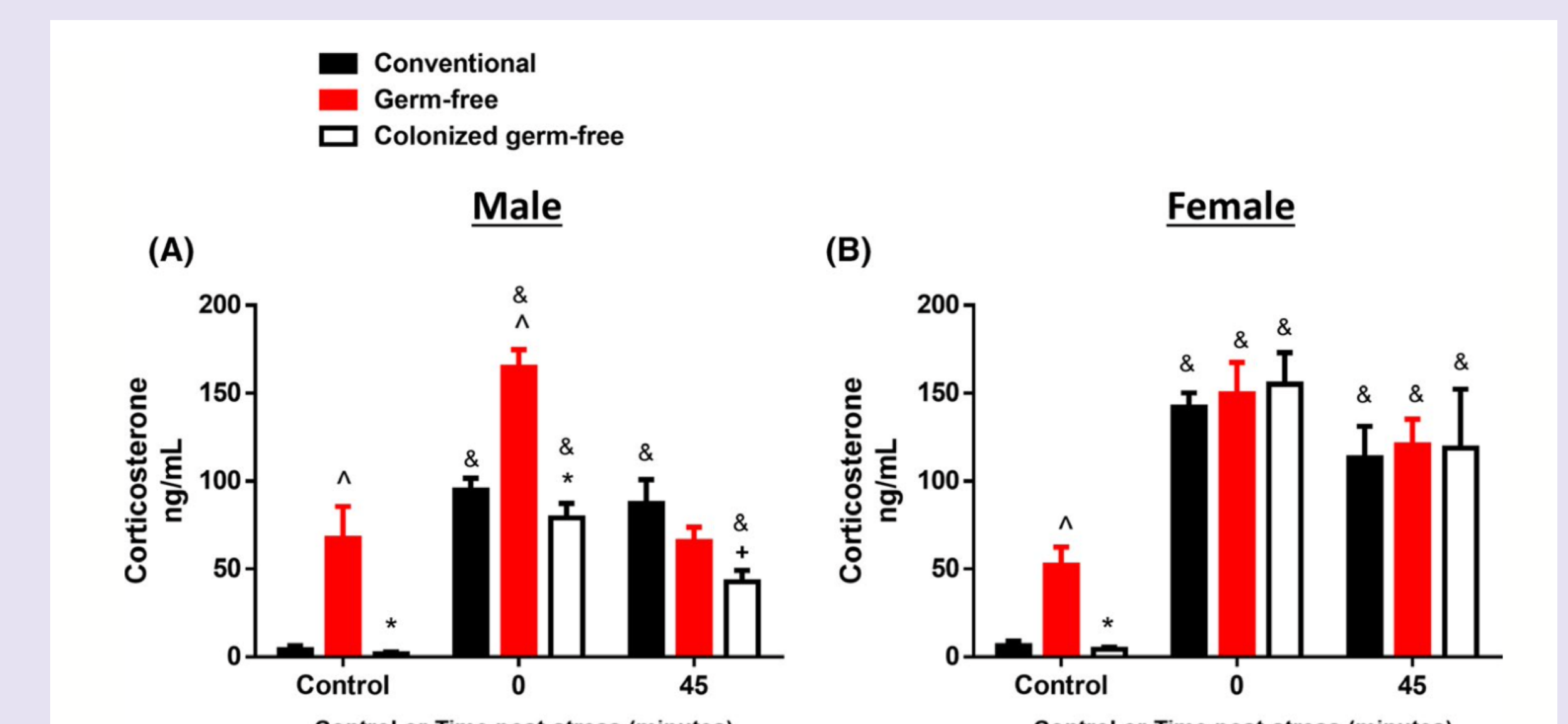


Fig 2. Stress affects corticosterone (ng mL⁻¹) response to acute stress in male (A) and female (B) mice in a sex- and microbiome- dependent manner. Showed significant differences at P < .05 level. (Lyte 2020)

- Recent evidence has shown the *Clostridaceae* family of bacteria specifically with Social Anxiety disorder
- The figure on the left shows the general communication between the gut and the brain. However, the specific mechanism in which neurotransmitters like serotonin and cortisol from the gut communicate with the brain remains unclear.

FUTURE DIRECTIONS

- The future directions based on this review are to explore the many types of microbiota that are present in the gut and see whether there is a specific type of bacteria or a family of bacteria that has a positive correlation with reducing anxiety.