



That Gut Feeling: Anxiety and the College Student Gut Microbiome

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BACKGROUND

Anxiety is the most prevalent global mental health condition.

Over 301 million people were affected in 2019, making up 4% of the world population (WHO, 2023). Specifically, the college students population is susceptible to anxiety, with 34.6% of students disclosing an anxiety disorder and 35.1% reporting their anxiety affects their academic performance (Tan, 2023). Students encounter many stressor, such as academic pressures, relationship dynamics, financial concerns, future plans, among others (Beiter, 2015). The college environment has multiple factors that influence mental processes.

Generation Z makes is the consists of the young adults born between 1997 and 2021. They have lived through generationally shaping events like the great recession of 2008, rapid advances in technology, multiple mass shooting, and the effects of a global pandemic. The Covid-19 pandemic caused long stretches of isolation, creating a lack of social interaction during key social developmental periods (Wang, 2021).

The “Most Anxious Generation”

Social connection is the best predictor of holistic health, this may explain why Gen Z experiences higher levels of anxiety compared to other generations (Villa, 2021). Post pandemic Gen Z reports (Harmony, 2023):

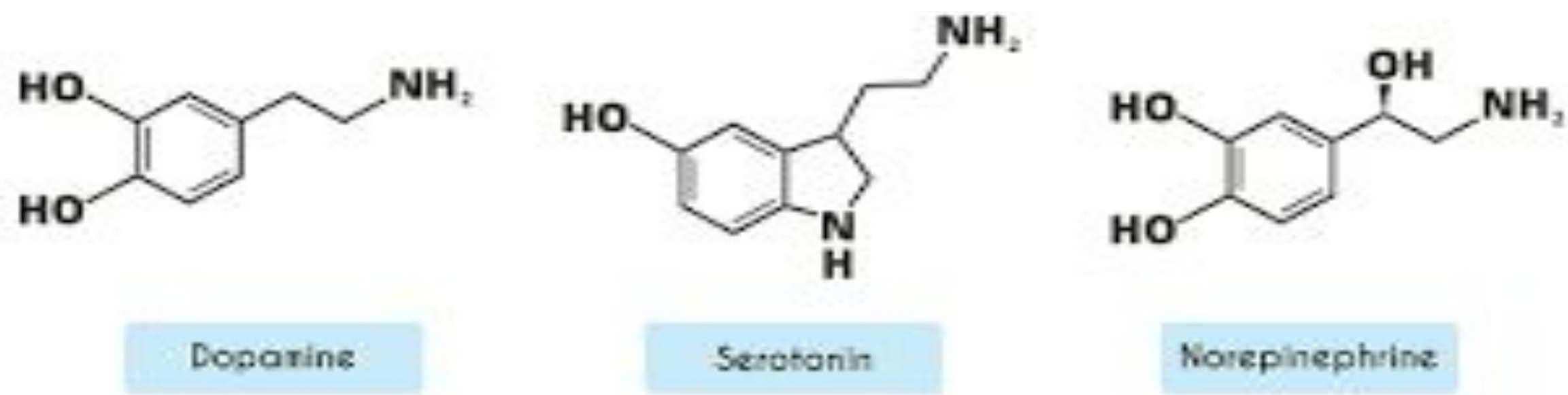
- 42% have been diagnosed with a mental health condition
- 1 in 4 were diagnosed during the pandemic
- 68% feel that the pandemic affected their mental health
- Anxiety is the most prevalent mental health condition in Gen Z

Stress and Anxiety

What is Stress?

Stress is a demand placed on the body in reaction to a stimulus (Island, 2024). The demand can both be positive (eustress) which causes a motivation and stimulation, or negative (distress) causing physiological or psychological discomfort (Selye, 1956). General adaptive syndrome is the body's natural response to distress, including three major stages: Alarm, resistance, and exhaustion. These are short-term and predictable physiological responses. Whereas anxiety is persistent, long-term worry that is accompanied by cognitive, behavioral, and physiological changes.

When physiological effects become severe, contributes to **Generalized Anxiety D/O**. Neurochemistry modulated self-regulation, with the signals of neurotransmitters (NT) serotonin, dopamine, and norepinephrine all having effects on mental processes. Serotonin specifically is a key modulator of mood, sleep, and overall wellness. These neurotransmitters are all synthesized from aromatic essential amino acids like tryptophan, phenylalanine, and tyrosine. Essential amino acids are important biosynthetic precursors for neural communication. These are not synthesized in the body, but acquired through the consumption of nutrients in food.



THESIS

Anxiety experienced by college students is affected by the microbial composition in the gut, a balance that can be altered by various nutritional factors.

EVIDENCE

Nutrition

Balanced nutrition is the inclusion of major macromolecules, protein, carbohydrates, fats, nucleic acids, as well as, necessary vitamins and minerals (WHO, 2024). The benefits of balanced nutrition are protective from disease and malnourishment.

Positive relation between energy-dense nutrient-poor food intake and campus food purchasing in university students (Image Credit: Whatnall, 2024)

	Percentage Energy from Energy-Dense, Nutrient-Poor Foods					
	Unadjusted Model			Adjusted Model		
	β -Coefficient ^a	SE	p	β -Coefficient ^a	SE	p
Frequency of purchasing food and beverages on campus			<0.001			<0.001 ^b
Reference category = Never						
Monthly or less	3.832	3.417	0.263	3.036	3.420	0.375
Fortnightly	7.978	3.569	0.026	7.789	3.585	0.031
Once a week	8.010	3.358	0.018	7.835	3.372	0.021
2-3 times a week	14.203	3.365	<0.001	14.180	3.412	<0.001
≥4 times a week	18.268	3.854	<0.001	18.041	4.032	<0.001
Weekly expenditure on food and beverages on campus ^c	0.199	0.040	<0.001	0.203	0.043	<0.001 ^d

In a study observing eating behavior and daily food consumption, Ntenie found that students surpasses the daily energy intake of for carbs by 13% (Ntenie, 2022). Also reporting that 21% of students were not eating a diversified diet. Cravings of sugar is correlated with serotonin, making them “comfort foods” (Suarez, 2023).

Long-term consumption of refined carbs affect anxious behaviors.

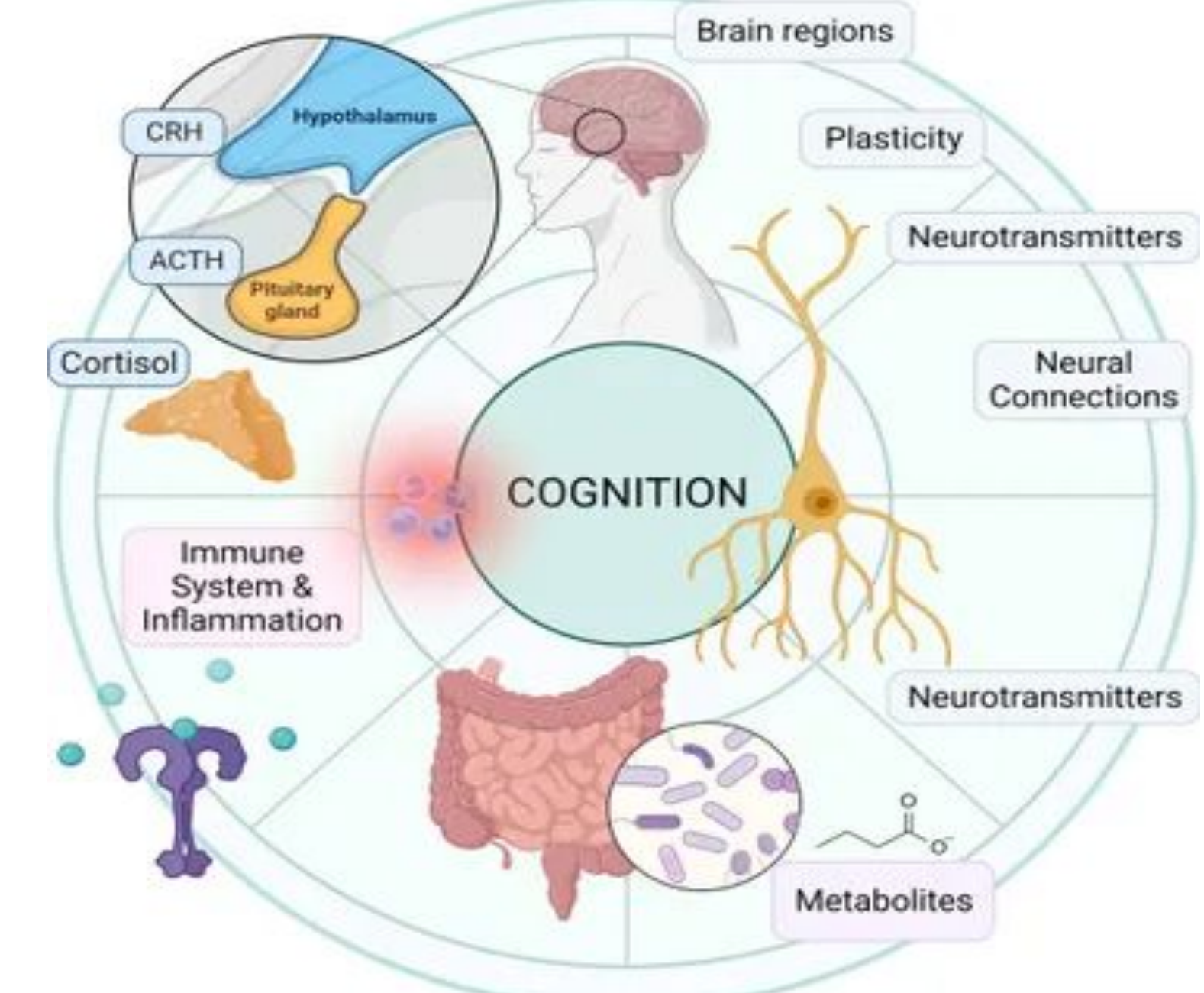
Research evaluating the effects of high-refined carb diets on neuroinflammatory responses and anxiety showed that short-term eating had no effects, but chronic eating of high-refined carbs induced anxious behaviors by the activation of cytokines and microglial cells in the prefrontal cortex (Gomes, 2020).Carbs are needed for metabolic function, but the overconsumption of glucose induces anxious behaviors. **Why does the body crave this excess glucose?**

Candida Albicans

C. albicans is a fungal opportunistic pathogen living symbiotically within the mouth, genital, and gastrointestinal regions or the human body. **Opportunistic pathogens** do not cause harm unless specific condition allow a species to proliferate, becoming pathogenic and over taking the microenvironment.

C. albicans metabolizes glucose for survival. With an increase of sugar, the concentration of the species increases. **The depletion of glucose effects the enteric nervous system, signaling sugar cravings to the brain** (Wise, 2023). Candida is capable of inducing insulin, further decreasing blood glucose levels (Nikolic, 2022). Triggering the activation of cortisol, which induces anxious behaviors (Markey, 2020).

The gut microbiota influences the HPA axis and cognition (Image Credit: Rusch, 2023)



Gut-Brain-Axis

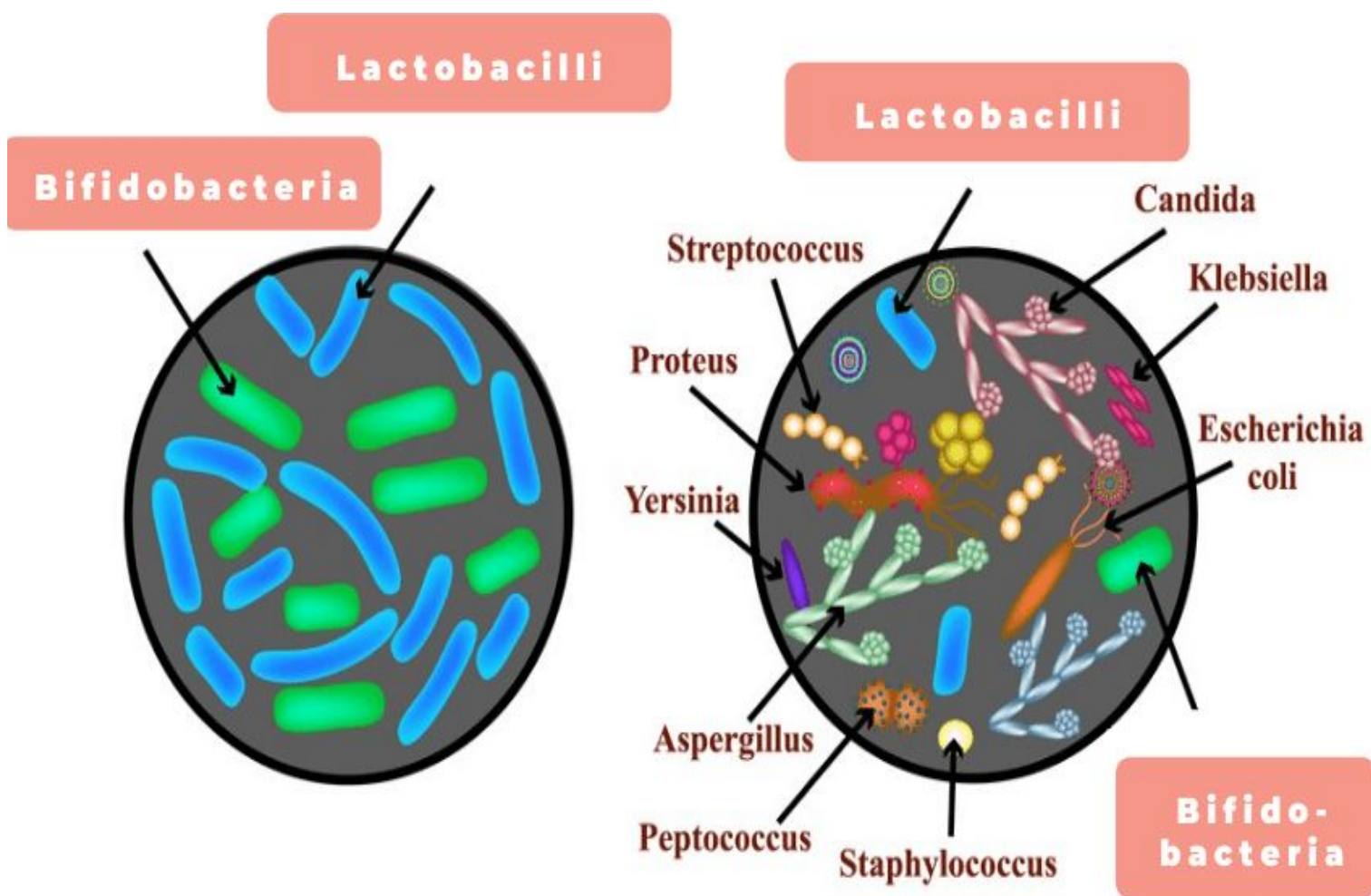
The GBA is the connection between cognition and peripheral gastrointestinal function. Talking back and forth through neural, endocrine, and immune signaling (Carabotti, 2015)

GAD patients have decreased microbial diversity and composition of bacteria associated with intestinal barrier function and inflammatory responses (Jiang, 2018)

Dysbiosis

Dysbiosis is the disruption of the microorganisms living in the gut (Degruittola, 2016), increasing the quantity of pathogenic species like candida and decreasing “healthy” bifidobacteria and lactobacilli. Gut bacterial composition is influenced by nutrition (Zhang, 2015). Fecal samples of mice fed high-fat/cab had increased amounts of proteus and an absence of lactobacilli (Zhang, 2015).

Lactobacilli is a modulator of inflammation and NT secretion associated with wellness and GAD symptoms (Zhu, 2023; Photo Credit: Loik, 2004)



CONCLUSIONS

- College students are eating high carb and imbalanced diets that are accessible in the college setting
- Increased carb intake alters the gut microbiome, affecting mental processes and anxiety disorders

Proposed Intervention Methods

- Probiotic intervention
- Changes in lifestyle factors
- First Year Seminar (FYS) course

SEMESTER COURSE CALENDAR			WEEK 6	Gut-Brain-Axis	What is the GBA?
WEEK	LECTURE - MWF	WEEKLY TOPICS			Bacteria Means of communication How does diet impact bacterial composition DUE: Week Sleep Log and Reflection
WEEK 1	Introduction to Mental Health	Discuss General Overview of Mental Health: Signs and symptoms Common disorders and diagnosis Common factors that affect mental health discussion Lifestyle factors that affect mental health	WEEK 7	Anxiety and Depression	Anxiety and Depression Topics: Pathology of the disorders Signs and symptoms Treatments Crisis hotlines DUE: Neurotransmitter Write-Up
WEEK 2	Introduction to On and Off Campus Resources	Student Counseling Center Info: How to register for a session Introduction to the counselors Presentation on off-campus resources in the area Guest Speaker: Student Counseling Center DUE: Question, concern, and interesting topics	WEEK 8	Coping Mechanisms	Healthy Coping Mechanisms Examples: Journaling, breathing techniques, seeking support, positive reframing, acceptance Maladaptive Coping Mechanisms Examples: Substance use, procrastination, self-criticism, denial DUE: Mental Health Reflection
WEEK 3	Diet and Nutrition	What is Good Nutrition Macronutrients, vitamins and minerals Foods that benefit mental health: Neurotransmitters production and essential amino acids. Superfoods DUE: Counseling Center Reflection	WEEK 9	BREAK - No Classes	
WEEK 4	Meal Prep 101	How to Meal Prep for the Week: Portions of nutrients Prep strategies Make the most out of a grocery shop or the dining hall Recommended Recipes: Low sodium/ cholesterol ideas Spice combinations DUE: Diet and Nutrition Reflection	WEEK 10	Time Management Workshop	Planning and Scheduling: Weekly and monthly planning Resources Assign Presentation Groups DUE: Personal Coping Mechanism Reflection
WEEK 5	The Importance of Sleep	Sleep Cycle Overview What is the importance of sleep for the body Hormones and neurotransmitters involved Sleep Health Adequate hours Routine and sleep hygiene DUE: Homemade Recipe with Nutritional Values	WEEK 11	Benefits of Exercise	Exercise Programs Types of exercise Durations Benefits DUE: Time Management Reflection
			WEEK 12	Substance Usage	Substance Overviews Alcohol, marijuana, hallucinogenic, and opioids Effects on brain chemistry and mental disorders Work on Presentational
			WEEK 13	Review and Presentation!	

This FYS course would target incoming freshman and educate students about anxiety and provoking lifestyle choices. The goal of the course is to help develop skill and guide the adjustment to independence, ultimately to carry these habits into adulthood.

Select References

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