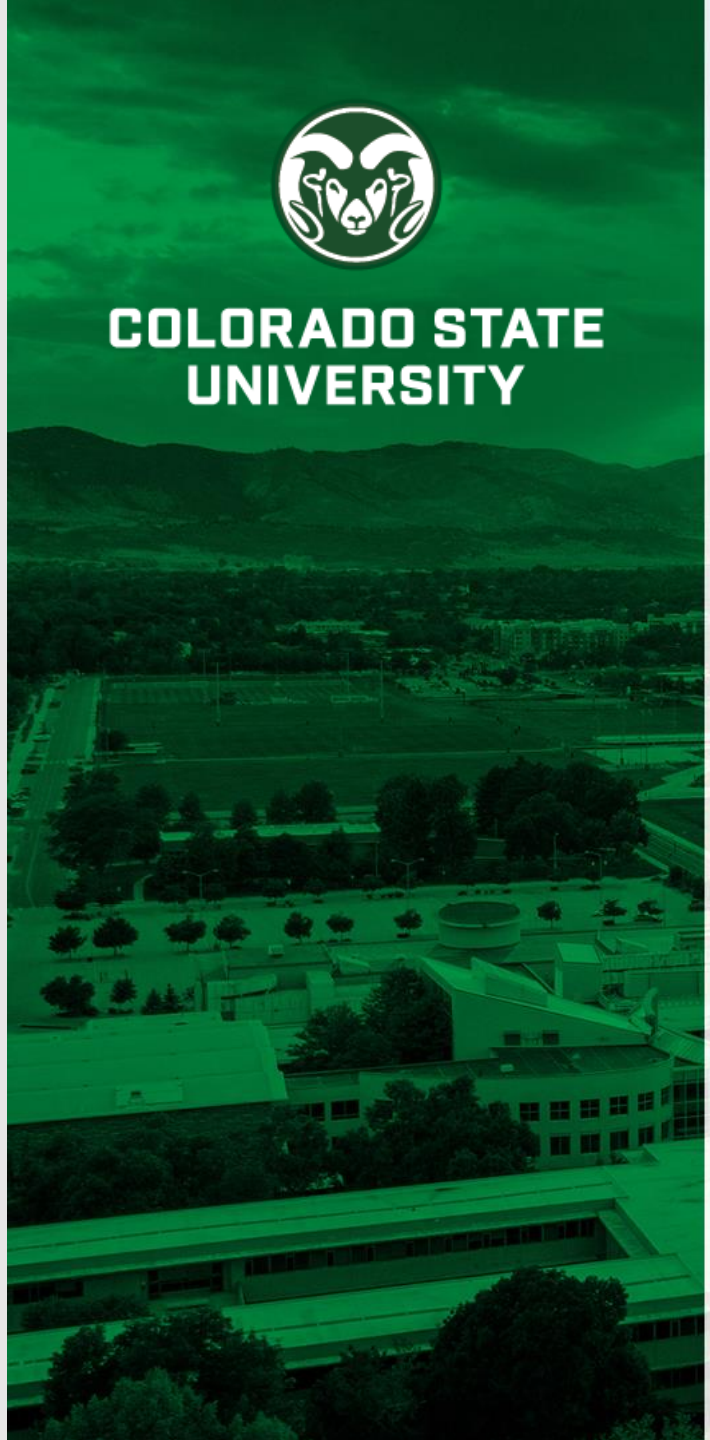
Office of Dietary Supplements Seminar Series

Dr. Minghua Tang

Dr. Victor Band

Dr. Mélanie Gareau

National Institutes of Health
Office of Dietary Supplements



Dietary intake, infant gut microbiome and growth

Minghua Tang, PhD
Associate Professor
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Colorado State University

First 1000 Days

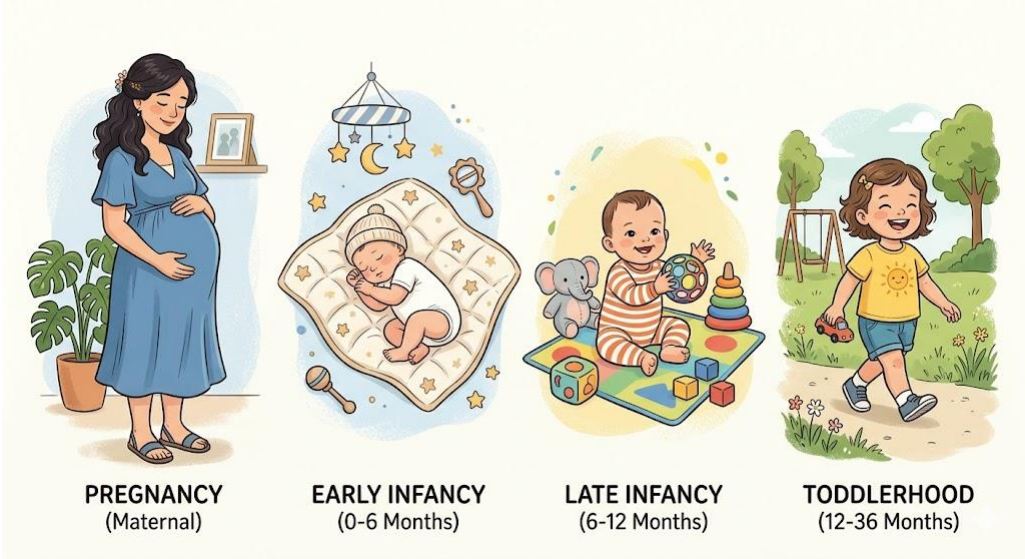
Complementary feeding

Pregnancy
Maternal nutrition
Prenatal care

0–6 Months
Liquid diet

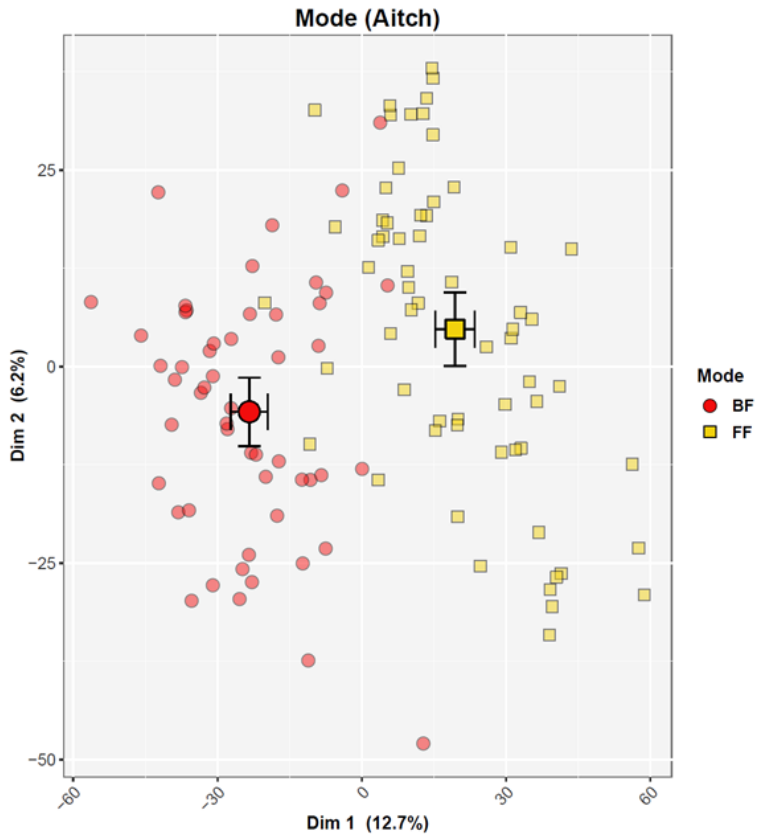
6–12 Months
Early complementary feeding+liquid diet

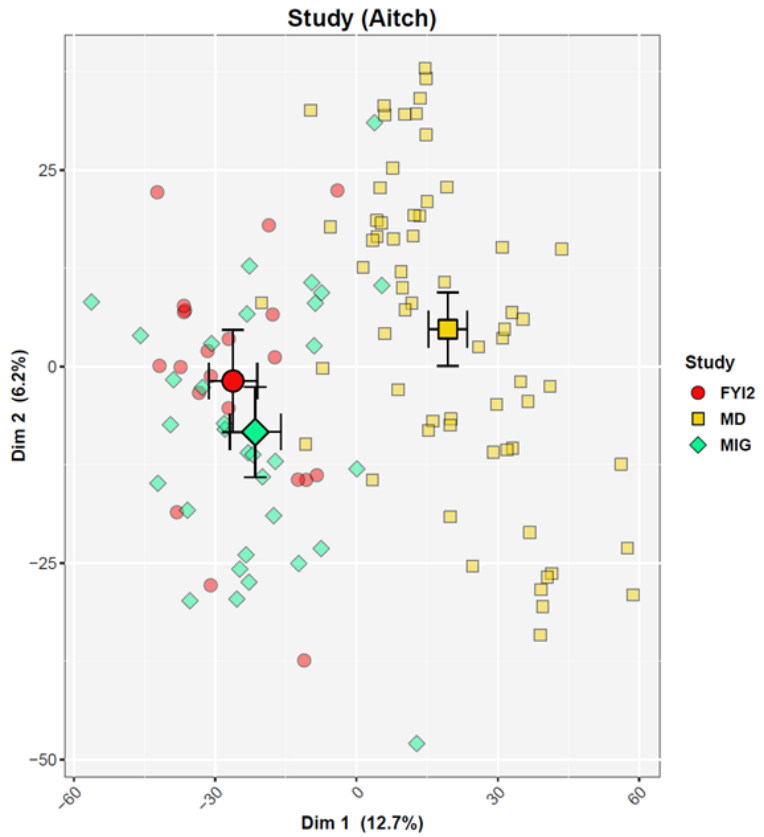
13-24 months
Toddlerhood



Liquid diet and infant gut microbiota

- Diversity differences
- Microbial composition differences
- More “mature” gut microbial composition in formula-fed infants.

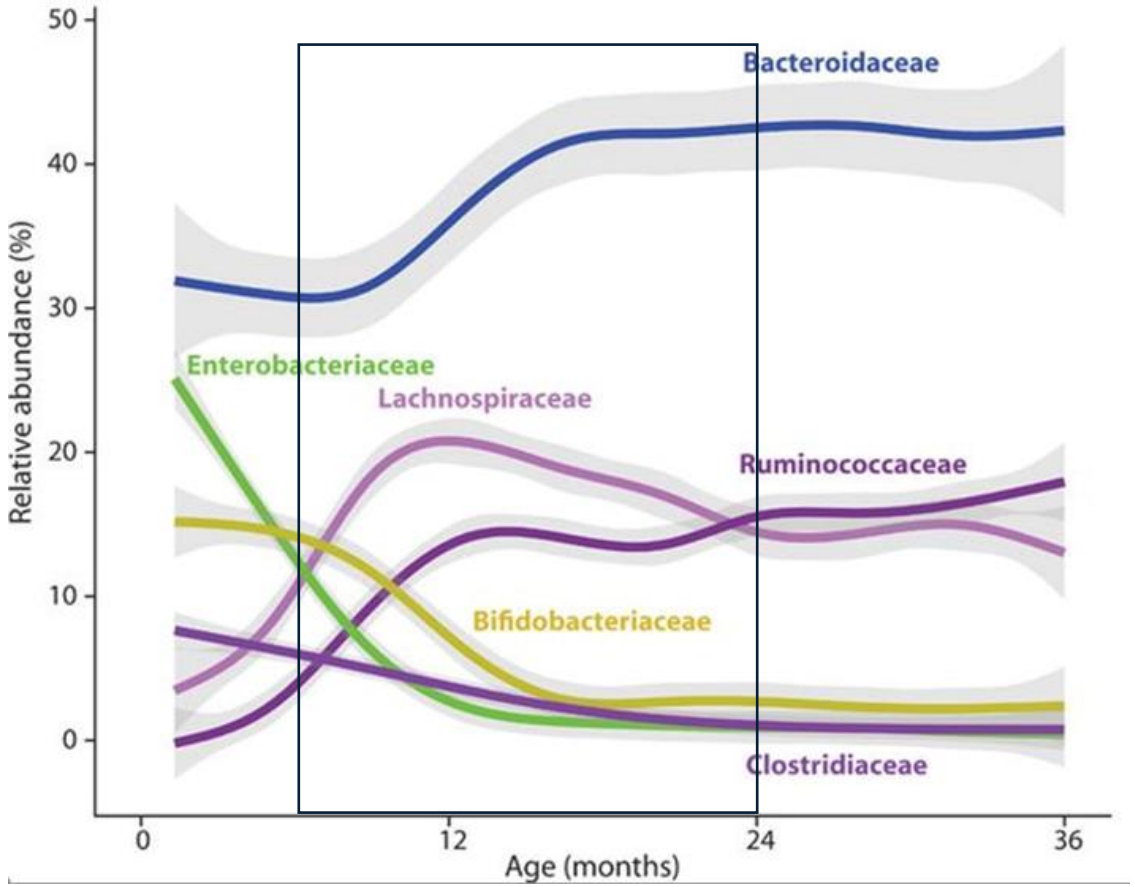




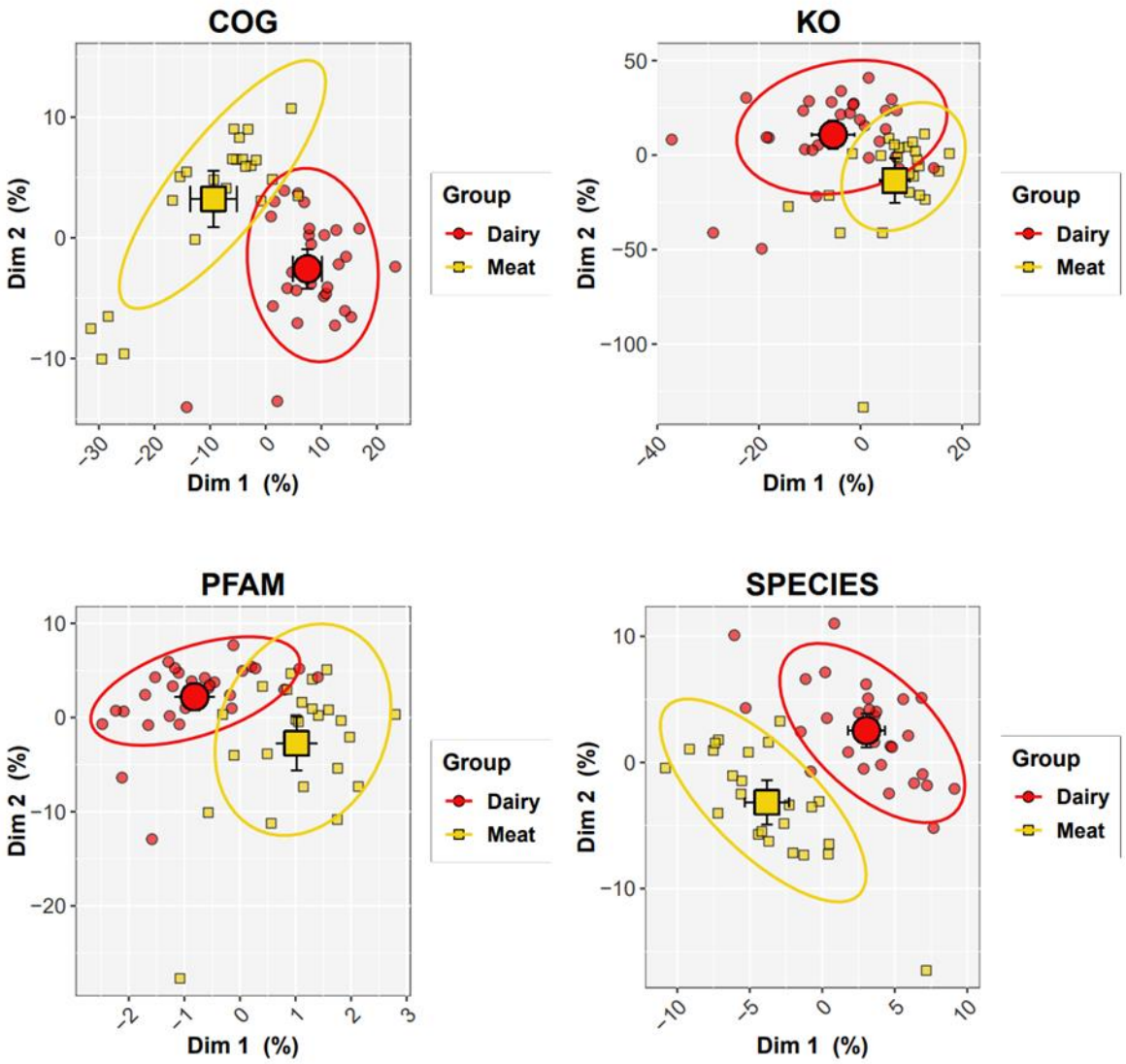
Odiase, Tang. The Journal of Nutrition 153 (9), 2612-2621

Complementary feeding & gut microbiota

- Introduction of solid foods increases microbial diversity and reduces the abundance of certain taxa.
- RCTs with multiple sampling and robust diet assessments are ideal for identifying the potential impact of complementary foods on gut microbiota.



Yassour M et al., Sci Transl Med 2016;8:343ra81



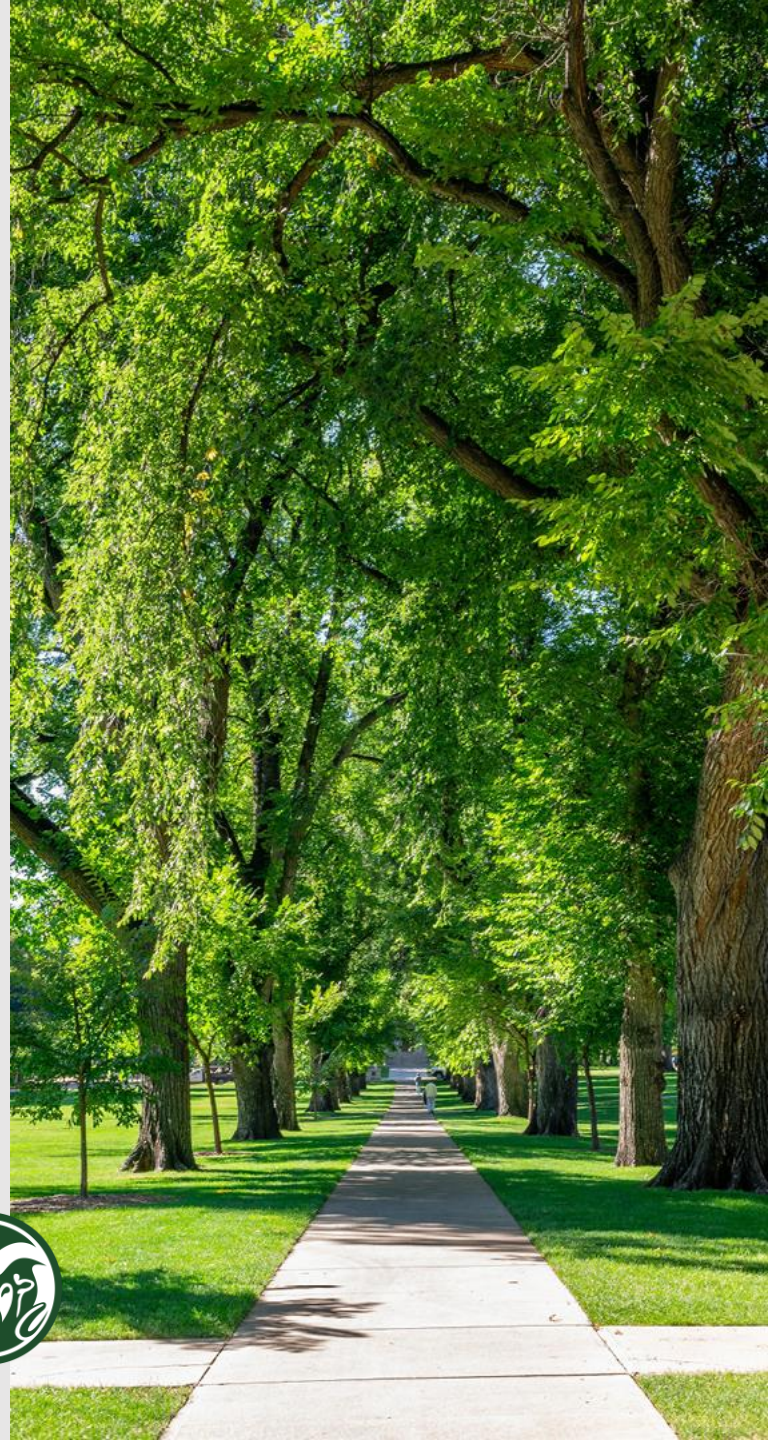
Microbial genetic feature separated between meat and dairy feeding groups at 12 months of age

Germ-free mice that received infant microbiome developed similar phenotypes as their donors while on the same diet.

	DAIRY GROUP (N=13)	MEAT GROUP (N=15)	P VALUE
Abdominal Fat (%)	11.4 ± 3.4	9.3 ± 1.7	0.061
Total Body Fat Volume (mm^3)	1974 ± 508	1658 ± 331	0.068
Total Brown Fat (mm^3)	106 ± 63	48 ± 36	0.007
Tibia length (mm)	0.95 ± 1.04	1.62±1.05	0.101

Current challenges and future directions

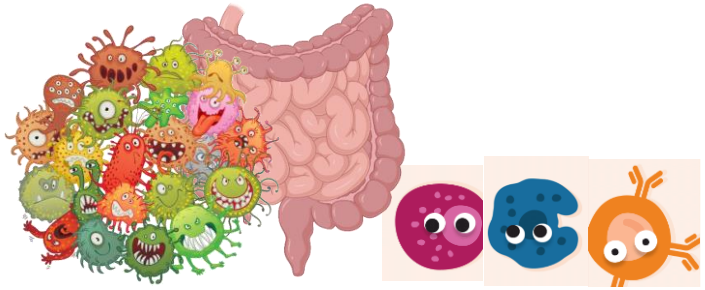
- Very limited research on how complementary feeding affects the infant gut microbiome and subsequently growth, especially RCTs.
- In-depth mechanistic investigations are also lacking (e.g., genetic features and fecal metabolites, causality).
- Functional outcomes need to expand beyond weight and length.
- Concurrently assessing dietary intakes.



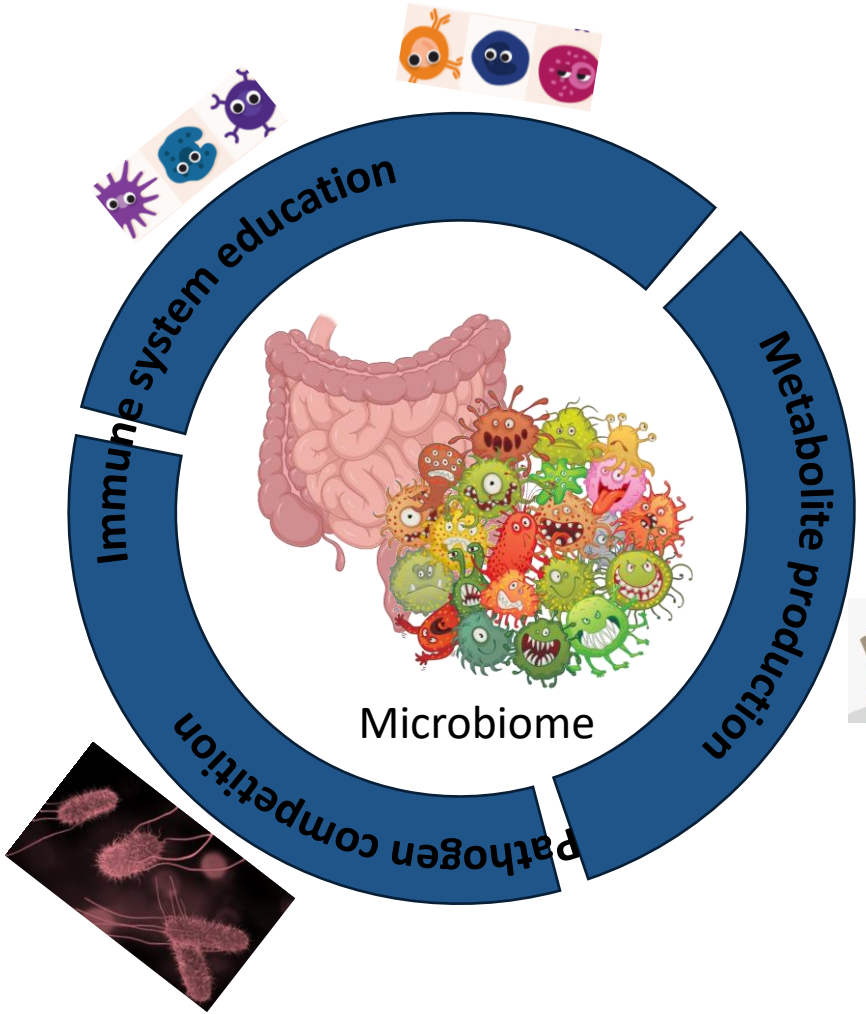
Microbiome production of metabolites augments immunity

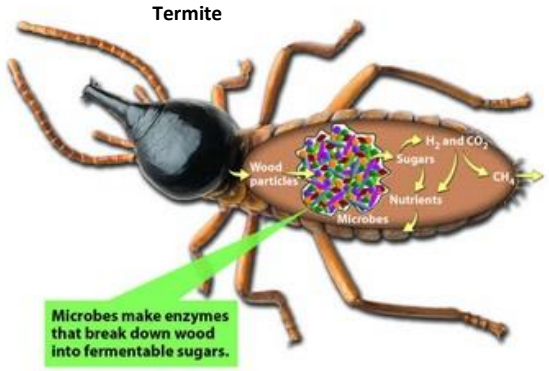
Beyond the Grant: Spotlight on ODS-Supported Research: Microbiome

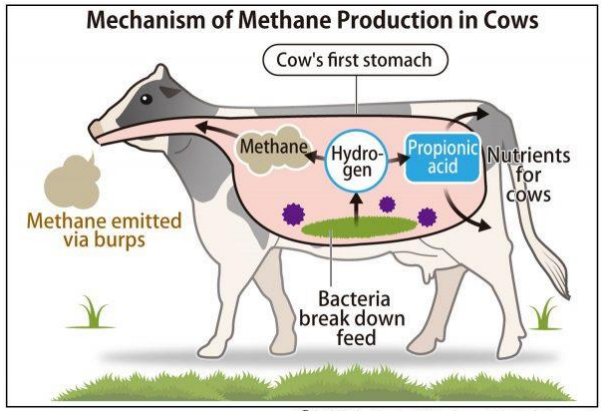
Victor Band
NIAID/DIR/LHIM

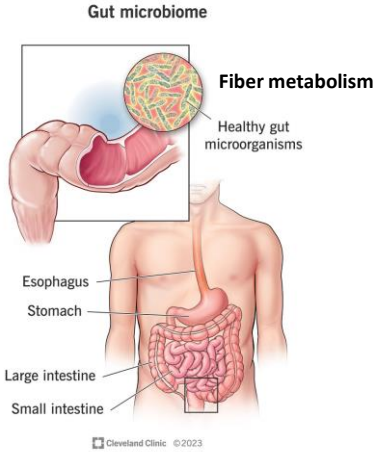


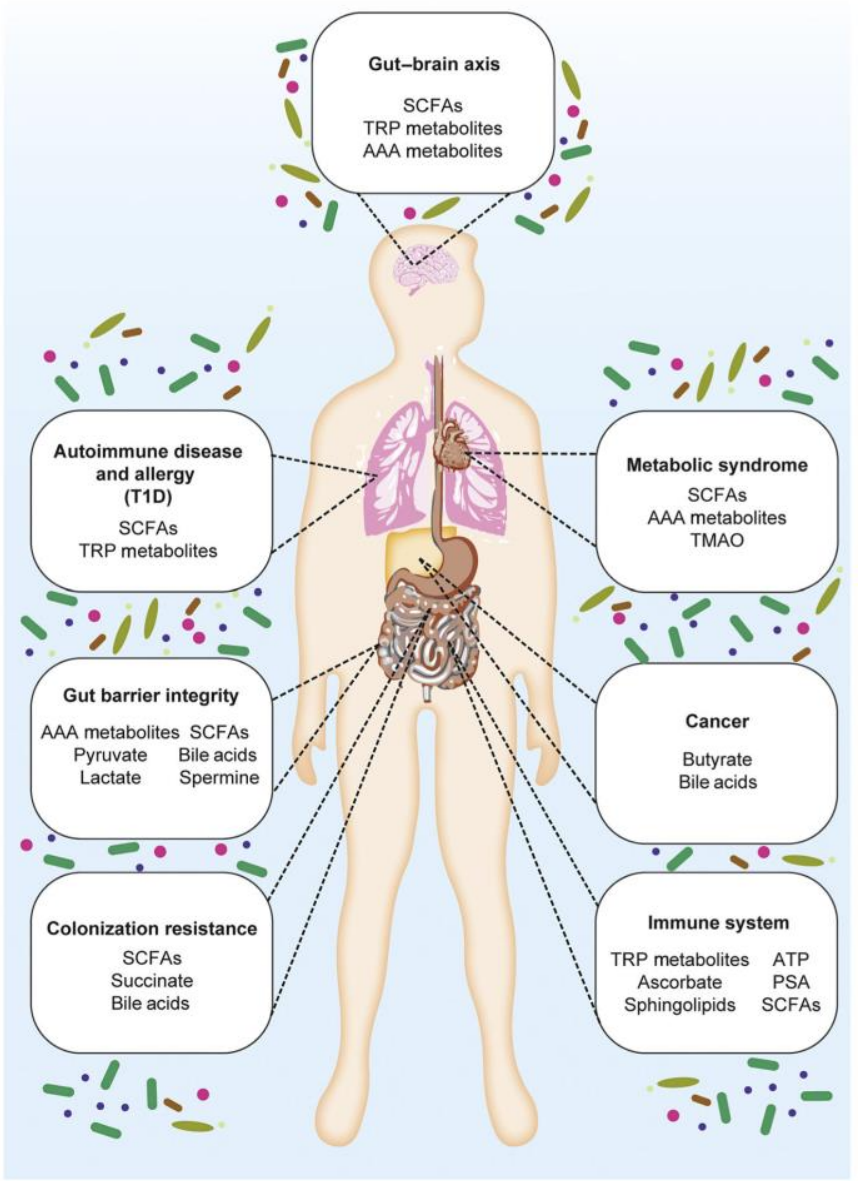
The microbiome is a key source of metabolites







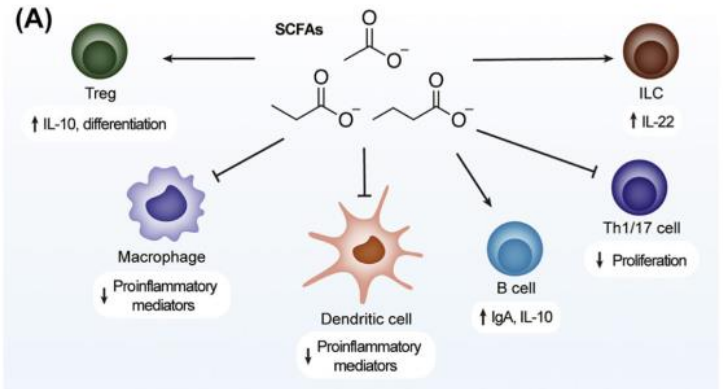


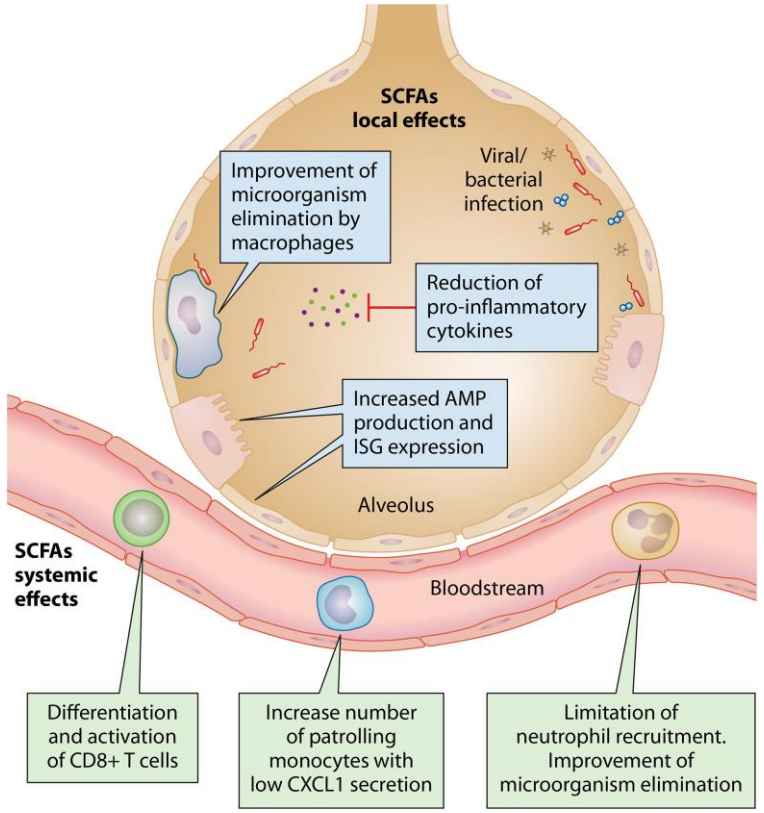


Nicolas et al 2019

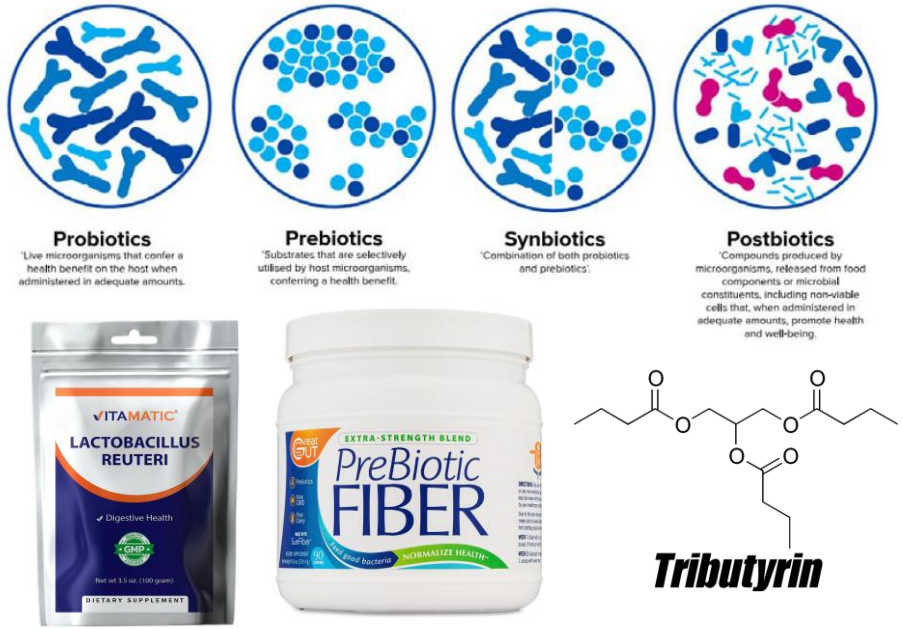
Microbial metabolites function to augment the immune system

Short Chain Fatty Acids (SCFA)





Synthetic Supplementation of SCFA



Completed
The Role of Short Chain Fatty Acids in Microbiota-gut-brain Axis (SCFA-AP)
ClinicalTrials.gov ID NCT03688854

Recruiting
The Effects of SCFA Supplementation in Subjects Receiving Abdominopelvic RT: A Rando Controlled Study
ClinicalTrials.gov ID NCT04700527

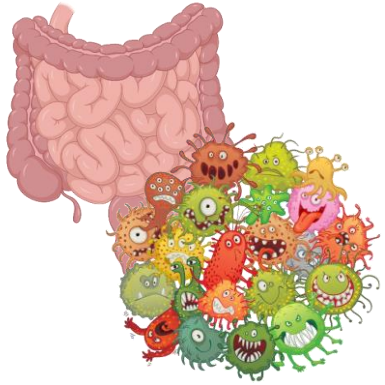
Completed
Impact of SCFA Supplementation on Metabolic Profiles in Serum and Urine of Kidney Transplant Recipients. (METAKID)
ClinicalTrials.gov ID NCT06951581

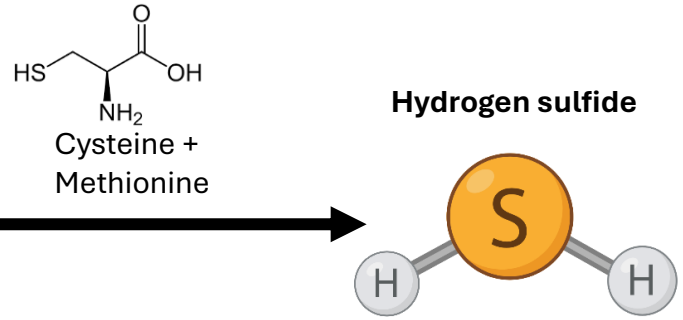
Recruiting
Microbiome Modulation With Prebiotics in PTSD and Cirrhosis (RESIST-PTSD)
ClinicalTrials.gov ID NCT06464952

Completed
Effects of Administration of SCFA in Rheumatoid Arthritis Inadequate Responders (EASi-RAIR)
ClinicalTrials.gov ID NCT05718583

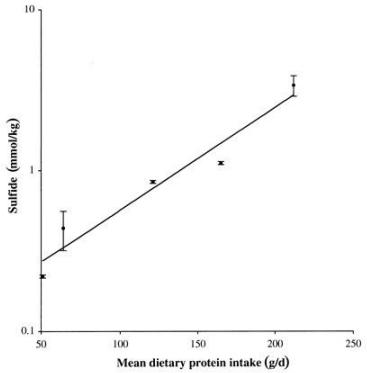
Nicolas et al 2019

Hydrogen sulfide (H2S) produced by the microbiome is an important microbial signal



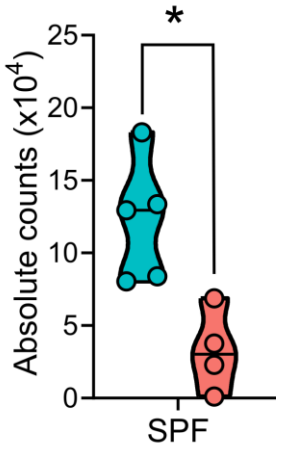


Cys/Met intake vs. H2S



Can we supplement dietary sulfides to augment immunity?

Loss of gut CD4 T cells



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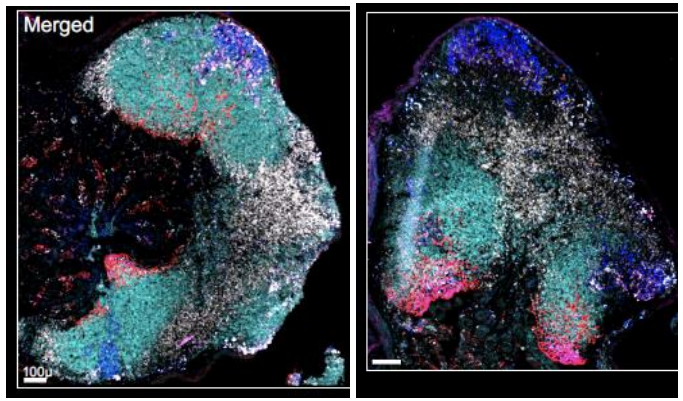
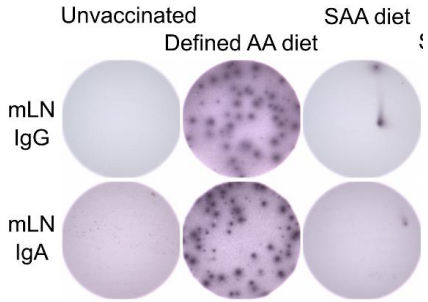
H2S depleted

Dysfunction of Peyers Patches



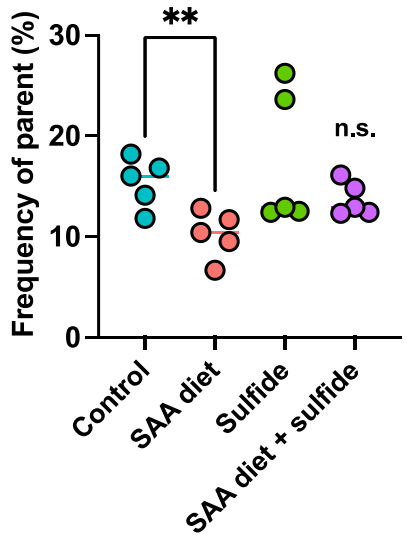
Ctrl H2S depleted

Reduced vaccine efficacy

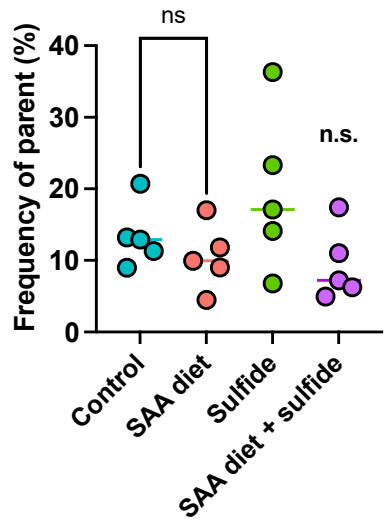


Ctrl H2S depleted

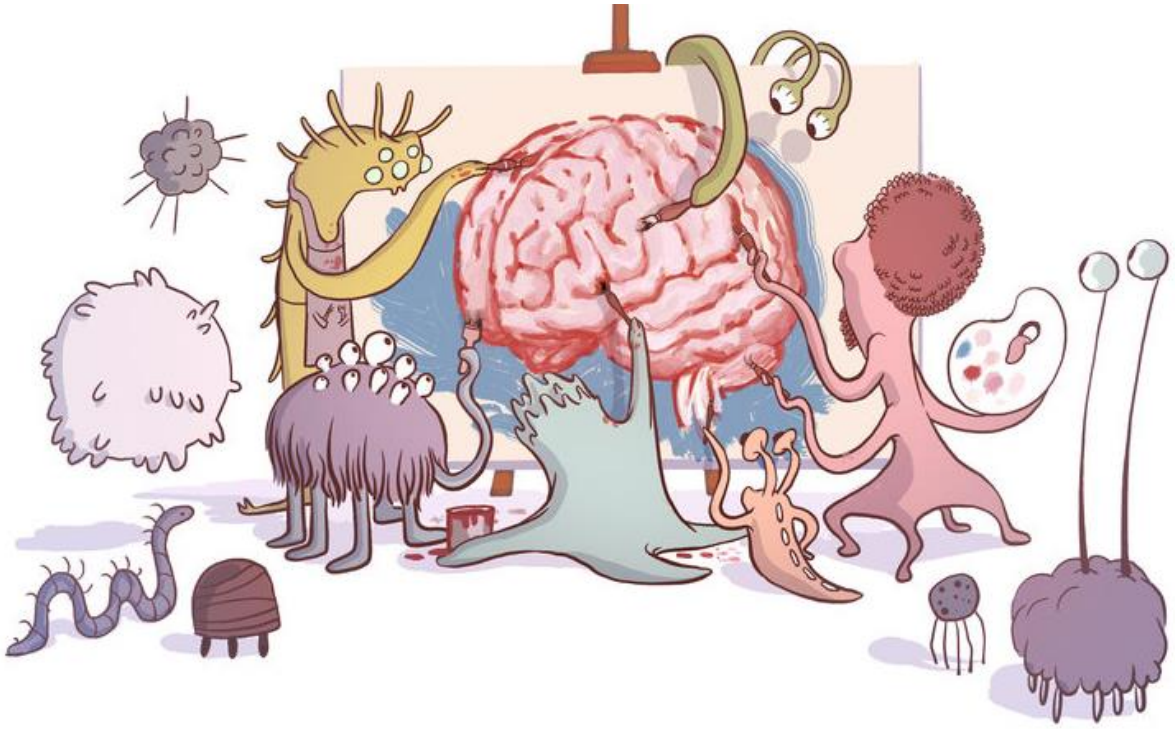
CD4 proliferation



CD4 IFNy production



The Developing Microbiota-Gut-Brain Axis:



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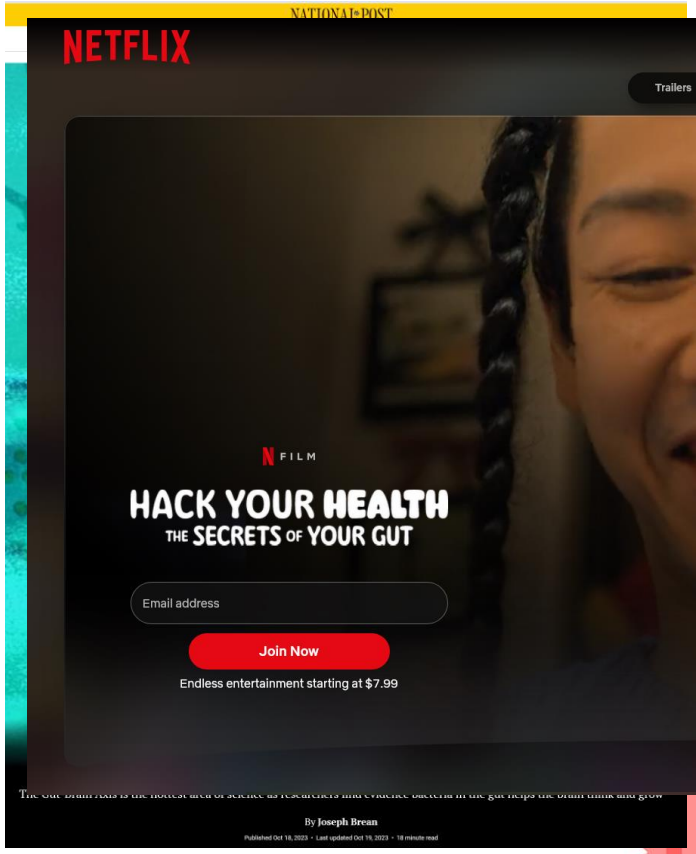
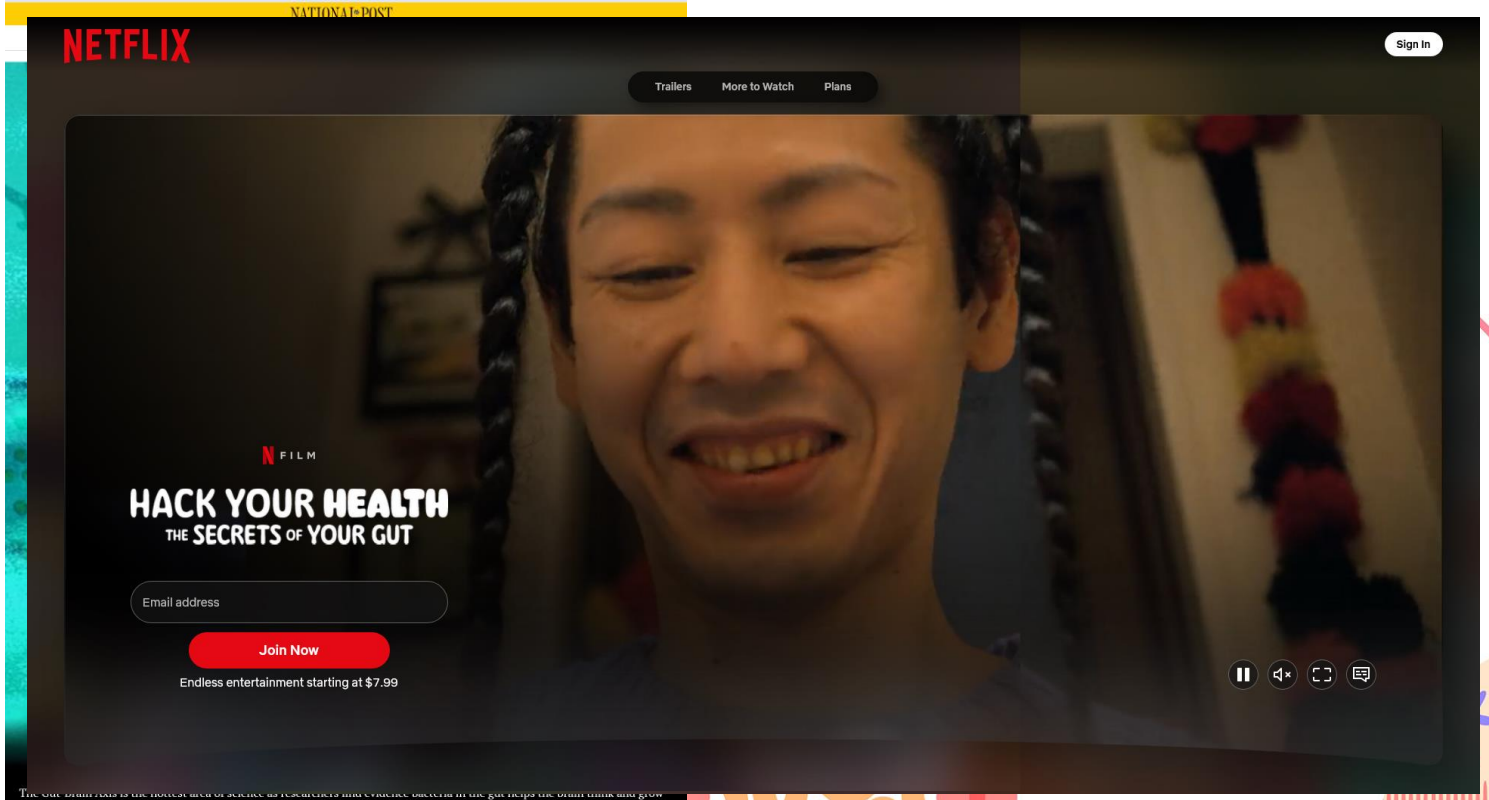
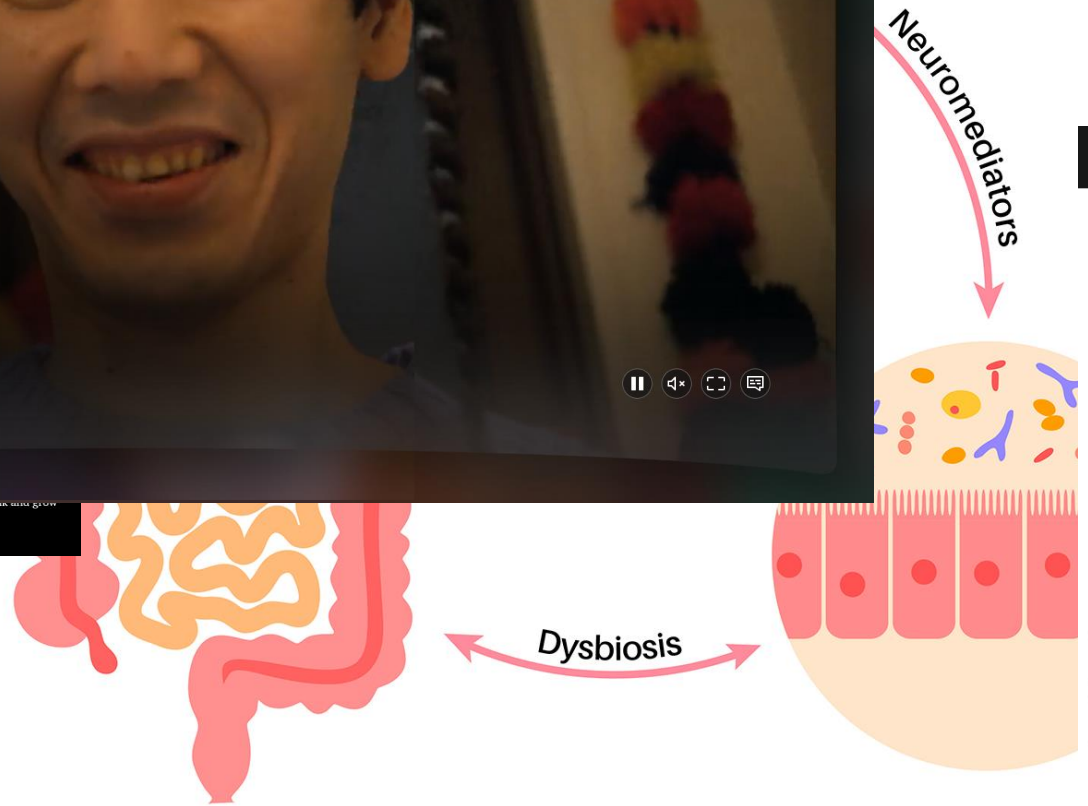
University of California, Davis

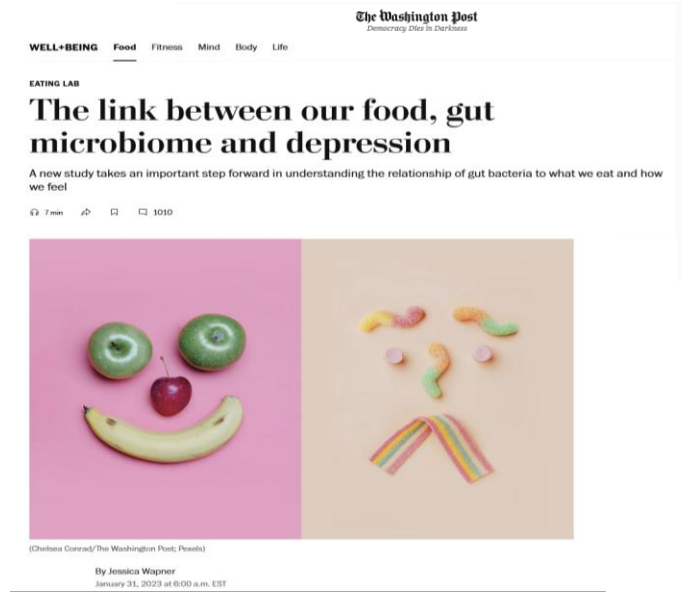
NIH ODS seminar | May 13th, 2026

“It’s all in your head”





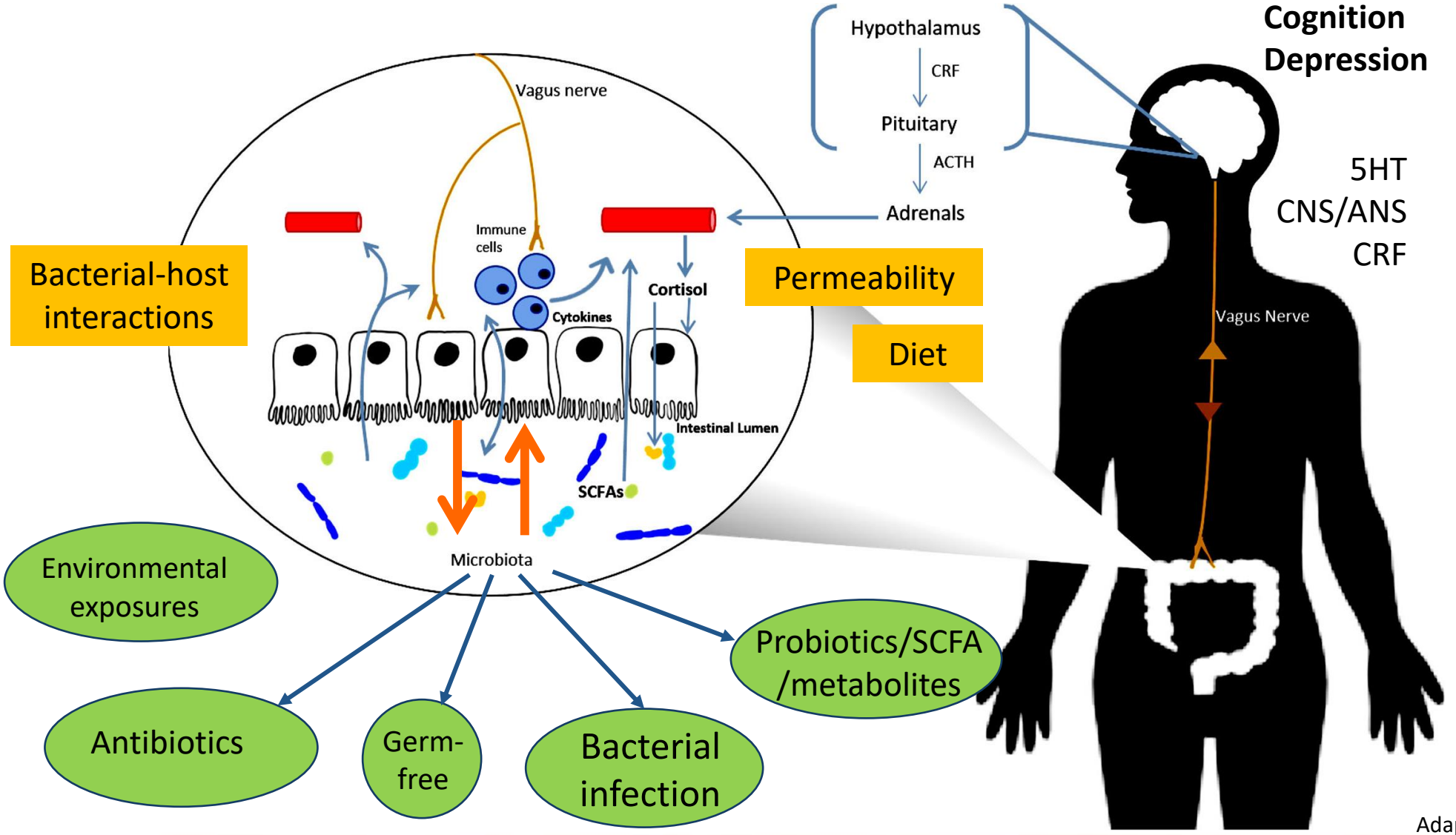




Microbiota-gut-brain (MGB) axis

Anxiety
Cognition
Depression

5HT
CNS/ANS
CRF



Bacterial-host interactions

Permeability

Diet

Environmental exposures

Antibiotics

Germ-free

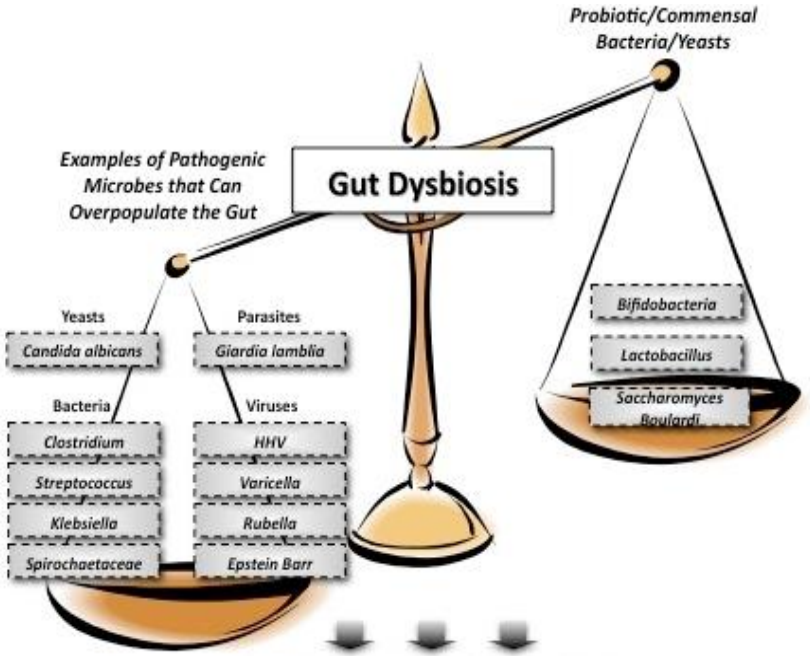
Bacterial infection

Probiotics/SCFA /metabolites

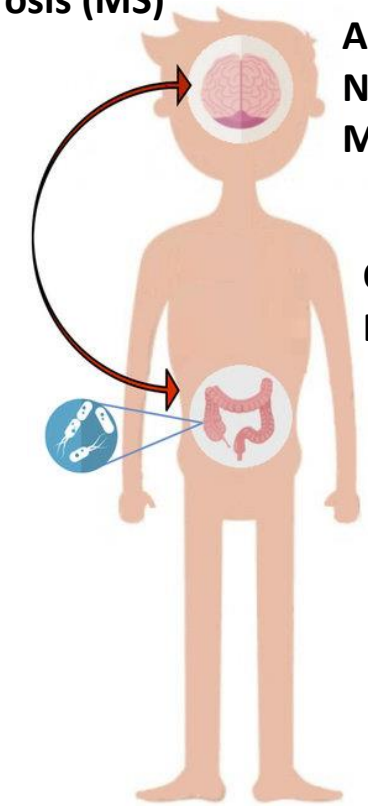
CRF – corticotropin releasing factor
ANS – autonomic nervous system
BDNF – brain-derived neurotropic factor
CNS – central nervous system
SCFA – short chain fatty acids
GF – germ-free
LPS – lipopolysaccharide
PGN – peptidoglycan
SCFA – short-chain fatty acids

Adapted from: Pusceddu, Curr Path Rep, 2018

Gut Dysbiosis



Parkinson's disease (PD)
Multiple sclerosis (MS)



Autism spectrum disorder (ASD)
Neurodevelopmental disorders (NDD)
Major depressive disorder (MDD)

Obesity
Diabetes

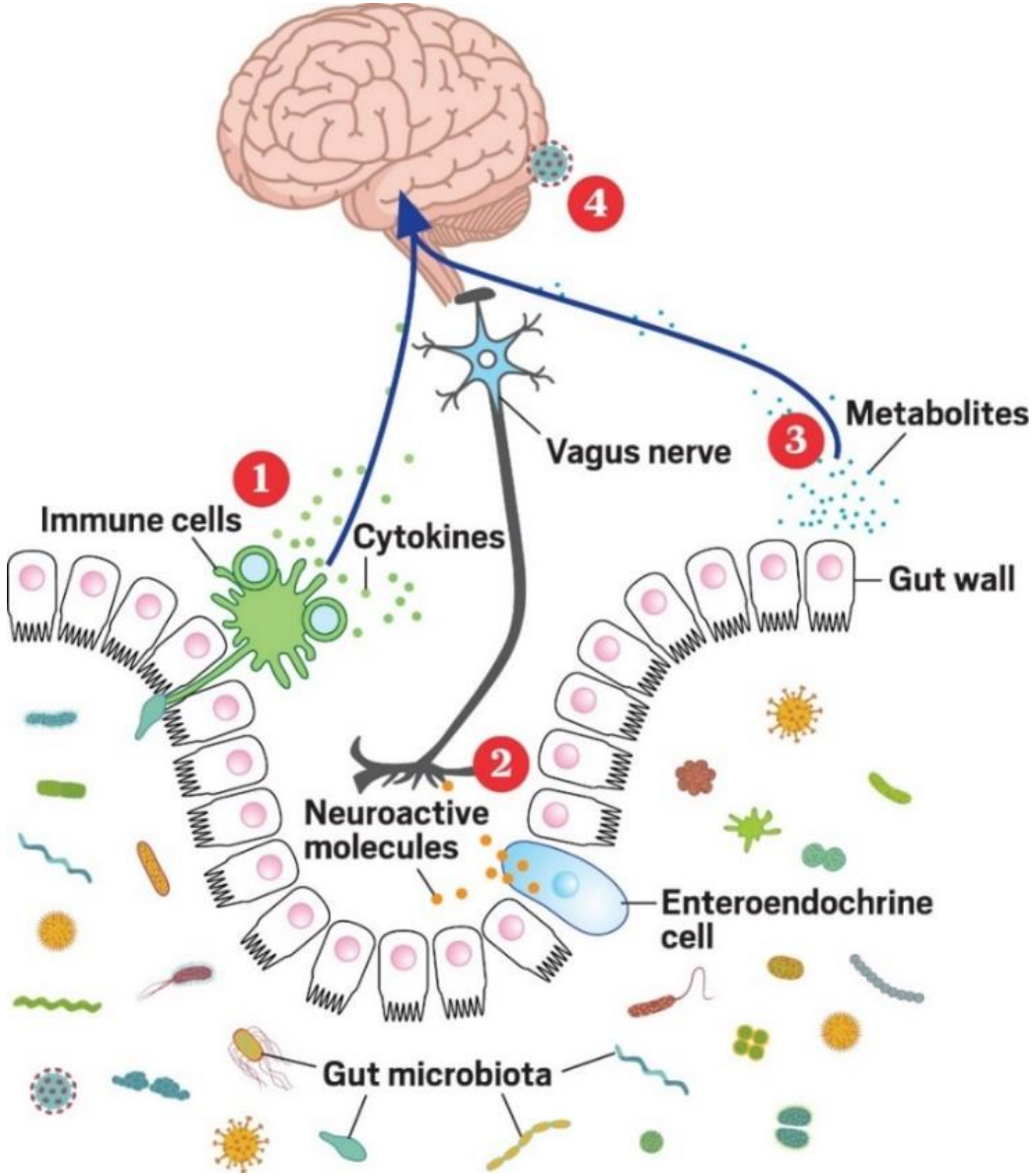
Inflammatory bowel disease (IBD)
Irritable bowel syndrome (IBS) or post-infectious IBS (PI-IBS)

Diseases of Gut-Brain Interaction (DGBI)

Host-Microbe Interactions

- Epithelial cells are in close proximity to microbes (10^{12}-10^{14} CFU in colon).
- Lamina propria contains immune cells, hormones, and neurons.

Immune cells (1), neurotransmitters (2), metabolites (3), and the vagus nerve (4) within the lamina propria are thought to be crucial for maintaining extra-intestinal signaling

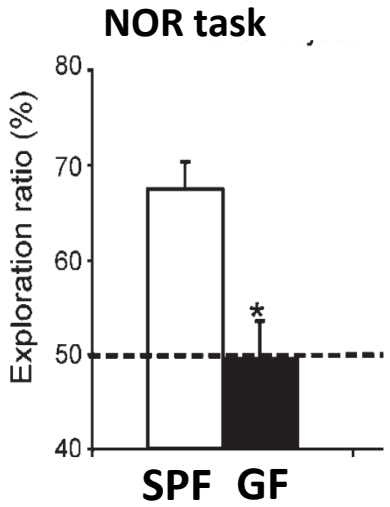


https://cen.acs.org/biological-chemistry/microbiome/gut-might-modify-mind/97/i14

Gut microbes regulate behavior

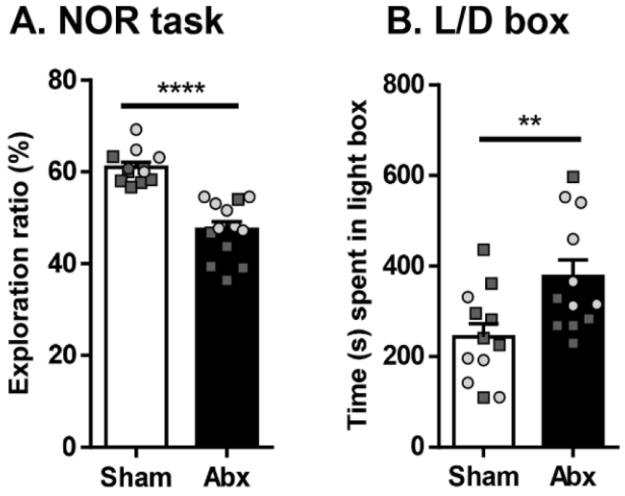
- Adult GF mice have cognitive defects and anxiolytic behavior (**Gareau et al. Gut, 2011**; Diaz et al. PNAS, 2011)
- Antibiotic-induced dysbiosis induces behavioral deficits (cognition/anxiety)
  - neonatal/adult mice (Leclercq, Nat Comm, 2015; **Keogh, BBI, 2021**)

Adult GF mice

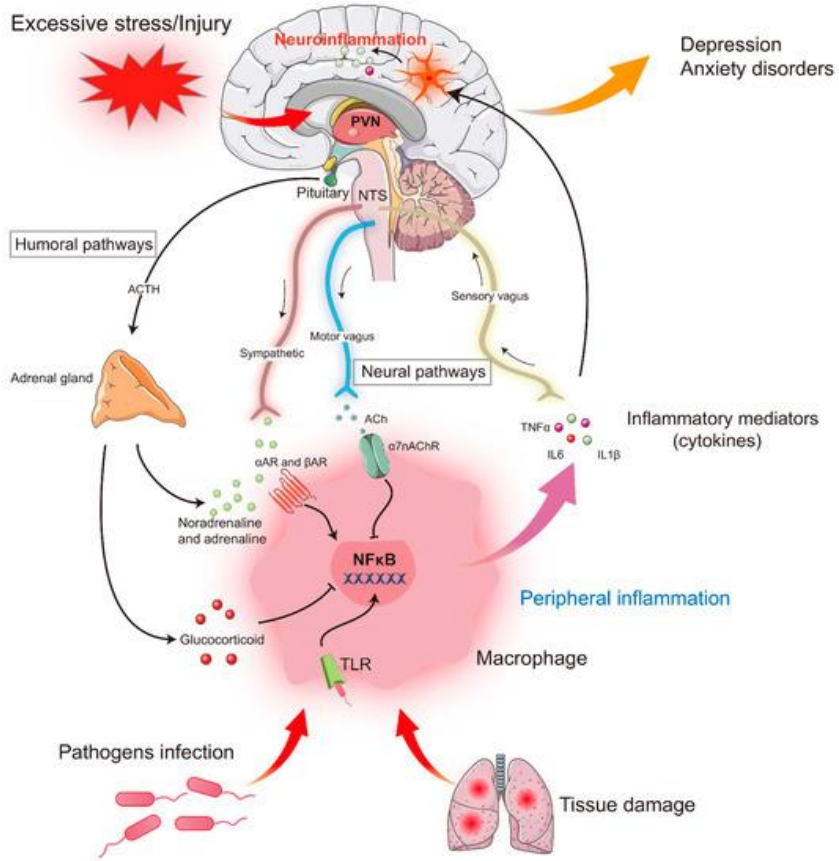


Gareau et al. Gut, 2011

Neonatal antibiotics

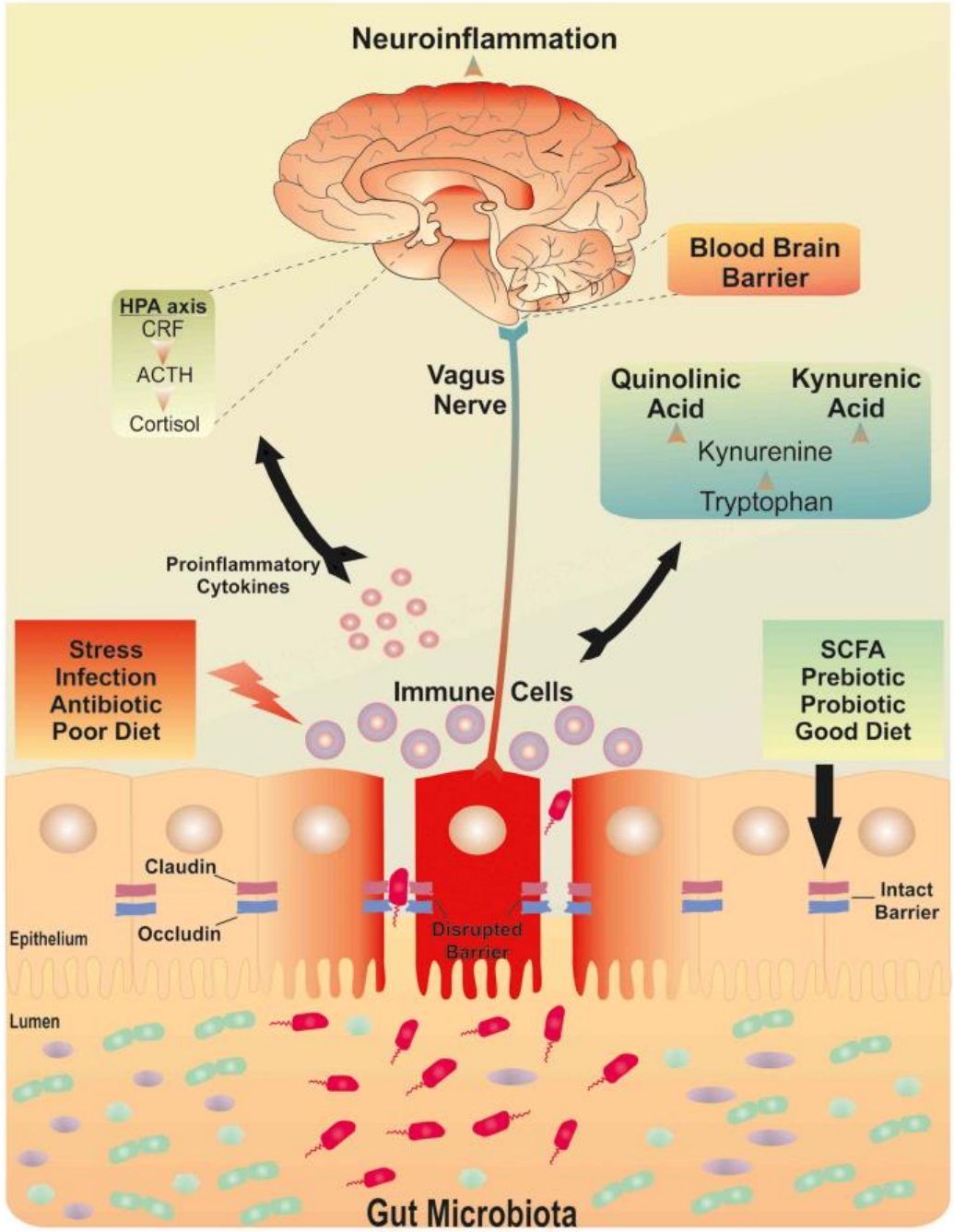


Keogh et al. , BBI, 2021



Hu, Int J Mol Sci, 2022

Microbiota-Gut-(Immune)-Brain axis?



Kelly et al. Frontiers in Cell Neuro, 2015

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