

**GI MICROBIOME & HEALTH:
A REVIEW**

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DISCLOSURES

- There are no disclosures

OBJECTIVES

- Definitions: GI microbiota, GI microbiome, probiotic, prebiotic
- Current ideas: GI microbiome and health
- Current ideas re: GI microbiome maintenance
- Current microbiome projects and goals

CURRENT ADVANCES

- NGS and gene editing (e.g., CRISPR)
- Nanotechnology
- Quantum computing
- Artificial Intelligence
- Online consumer
- Smart everything



PUBLISHED IN HEALTHLINE JAN 2019

- "Your gut microbiome is made up of trillions of bacteria and other microorganisms-both friendly and unfriendly.
- Maintaining the right balance of friendly and unfriendly bacteria in your gut is touted to improve digestion, reduce inflammation, decrease anxiety, and improve brain function and mood.
- A healthy balance of gut bacteria is said to boost metabolism, eliminate cravings, and help you shed unwanted weight."

A. Petri, MS, RD

GI MICROBIOME

- GI microbiota = all the bacteria in our GI tract
- GI microbiome = all the bacterial genes in our GI tract



GI MICROBIOME-THINK ABOUT THIS

- Human body has more bacterial cells than human cells
- Human body has more bacterial genes than human genes
- Bacterial metabolites influence human biochemistry
- Bacteria multiply rapidly, mutate, and exchange genes
- Our body bacterial genome is something we can change



CURRENT ESTIMATES

HUMAN VS BACTERIAL CELLS

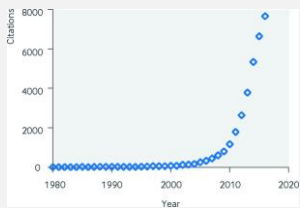
- 30 trillion human cells
- 39 trillion bacterial cells
- 43% vs 57% for cells

HUMAN VS BACTERIAL GENES

- 20,000 human genes
- 2-20 million bacterial genes
- 1% vs 99% for genes



MICROBIOME CITATIONS



COLONIC BACTERIA

- Bacteroides fragilis
- Bacteroides melaninogenicus
- Bacteroides oralis
- Enterococcus faecalis
- Escherichia coli
- Enterobacter species
- Klebsiella species
- Bifidobacterium bifidum
- Staphylococcus aureus
- Lactobacillus species
- Clostridium perfringens
- Proteus mirabilis
- Clostridium tetani
- Clostridium septicum
- Pseudomonas aeruginosa
- Salmonella enterica
- Faecalibacterium prausnitzii
- Peptostreptococcus species
- Peptococcus species

SCIENTIFIC PUBLICATIONS



WHAT THEY ARE SAYING

- GI bacteria:
 - regulate the health of GI tract epithelial cells
 - there are good GI bacteria and not good GI bacteria
 - number and type are regulated by our diet
 - influence body metabolism, body weight, immune system, behavior, diseases, response to medications
 - influence food choices
- GI bacterial diversity is favorable
- Diet influences GI bacterial diversity
- Diet high in fiber promotes GI bacterial diversity
- Role for fecal transplant in health care

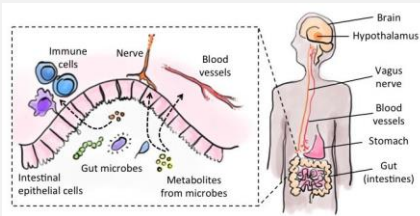


MORE DEFINITIONS

- Probiotic=bacteria that are beneficial to host GI
- Prebiotic=foods we eat that feed good bacteria



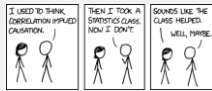
DIAGRAM OF GI EPITHELIUM AND BACTERIA INTERACTIONS



VIDEO

GI MICROBIOME BELIEVED TO PLAY A ROLE IN:

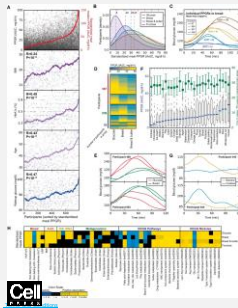
- obesity
- metabolic syndrome
- cancer
- IBD
- IBS
- arthritis
- asthma
- diabetes
- CNS disease
- GI ulcers
- heart disease
- liver disease



ZEEVI ET AL 2015

"PERSONALIZED NUTRITION BY PREDICTION OF GLYCEMIC RESPONSES"

- 800 people, continuous glucose monitor, measured their microbiome, measured their response to the same meals
- People eating identical meals present high variability in post-meal blood glucose response
- The response was related to microbiome
- Were able to design personalized diet to lower glycemic response
- Response to diet is predicted by microbiome
- Change in diet can change microbiome and glycemic response



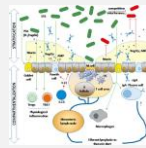
MICROBIOME AND WEIGHT

- GI microbiome analysis can predict with 90% certainty whether or not a person is overweight
- Human genome analysis can predict with 57% certainty whether or not a person is overweight.
- Twin studies
 - overweight twin had decreased bacterial diversity.
 - Non overweight twin had more: Christensenella and Akkermansia
- Germ free mice experiments



MICROBIOME AND IMMUNE SYSTEM

- GI microbiome believed to influence the development of the innate and adaptive host immune systems
- Scher, J. et al. "Expansion of intestinal Prevotella copri correlates with enhanced susceptibility to arthritis"
- Believed to be a role for intestinal bacteria in supporting the systemic immune response required for joint inflammation
- Also believed association with increased prevalence of asthma



MICROBIOME AND INTESTINAL DISEASE

- 2019 Nature Communications
- Haberman, Y et al. "Ulcerative colitis mucosal transcriptomes reveal mitochondrialopathy and personalized mechanisms underlying disease severity and treatment response"
- Identified positive associations between genes and pathways associated with UC severity and response to treatment and disease-linked microbial taxa.



MICROBIOME AND RESPONSE TO TUMOR TREATMENT

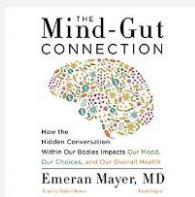
- The ability of gut microbiota to alter response to chemotherapy has been shown in animal models
- "Antibiotic treatment prior to immune checkpoint inhibitor therapy as a tumor-agnostic predictive correlate of response in routine clinical practice."
- Pinato, J et al, presented March 1, 2019
- Medications, esp antibiotics affect gut microbiome
- ?chemicals in food, ?artificial sweeteners

MICROBIOME AND CNS DISEASE

- Nutritional psychiatry:
- Jacka, F et al. "A randomized controlled trial of dietary improvement for adults with major depression" 2017
- Parletta, N et al. "A Mediterranean-style dietary intervention supplemented with fish oil improves diet quality and mental health in people with depression" 2017
- Role in neurodegenerative diseases: MS, Parkinson's



RECENT PUBLICATIONS (THERE ARE MANY)



JOURNALS



REVIEWS



PROJECTS AND ORGANIZATIONS

- Human Microbiome Project
- American Gut Project
- Center for Microbiome Innovation-AI for Healthy Living
- American-British Gut Project
- Infectious Disease and Microbiome Project
- Global FoodOmics Project
- Mayo Clinic Microbiome Project



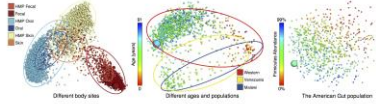
american gut YOUR AMERICAN GUT SAMPLE

MICHAEL POLLAN

What's in your American Gut sample?



How do your gut microbes compare to others?



PROJECT GOALS AND ACHIEVEMENTS

- Collect and categorize microbiome data
- Data is open and free for research
- Apply AI to interpretation of microbiome data
- Review microbiome taxa to predict disease

ROLE OF FECAL TRANSPLANT

- History of use with *C. difficile*
- Current modes of transplant



RESEARCH EFFORTS

- Dr. Tim Spector
- King's College London
- Author:
 - Identically Different: Why You Can Change Your Genes 2012
 - The Diet Myth: The Real Science Behind What We Eat 2015
- Dr. Rob Knight
- UCSD, La Jolla, CA
- Cofounder: American Gut Project
- Cofounder: Earth Microbiome Project

CONCLUSIONS FROM DR. SPECTOR

What we Know:

- Probiotics have beneficial effects on human health
- Gut microbes influence human energy metabolism
- Diet and medication have a strong influence on gut microbiota
- Microbiota composition influences response to chemo and immunotherapy
- Microbiome composition defines glucose response to foods and can be used to personalize diet
- Dietary fiber intake influences gut microbiota and is related to better health

What we don't know:

- Are natural probiotics in food better than probiotic supplements? Should we take them preventively?
- Can microbes influence food choices and appetite?
- Do low dose antibiotics in food affect human health?
- The effect of pesticides in food on the gut microbiome? Is organic food better?
- Should all new drugs and food chemicals be tested on the gut microbiota?

DIETARY RECOMMENDATIONS FOR HEALTHY GI MICROBIOTA

- Plant-based complex carbohydrates (variety important to promote diversity)
- Plant-derived fats
- Grains
- Fish and chicken better
- Polyphenols (olive oil, red wine)
- Plant products regarded as anti-inflammatory (turmeric, curcumin, ginger)
- Naturally fermented foods (contain microorganisms)
- Avoid red meat and animal fat
- Avoid refined sugar and processed food



WHY ARE THESE FOODS REGARDED AS GOOD?

- These foods are believed to:
 - increase bacterial diversity (bacterial food source)
 - increase number of health-promoting bacteria
- Health-promoting bacteria:
 - are believed to reduce intestinal permeability ("leaky gut")
 - are believed to be good for brain

IN SUMMARY

- "Research suggests that the relationship between gut flora and humans is not merely commensal (a non-harmful coexistence), but rather is a mutualistic, symbiotic relationship."



GI MICROBIOME!

- GI microbiome is important in health and disease
- Thank you for your attention
- nck@usa.net