The Microbiome: Healing the Gut Brain Axis
MAND 2016

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Microbiome

- 2-6 pounds of microbes live on our epithelial surfaces
- Microbes outnumber human cells 10/1
- Microbial DNA: Human DNA = 150/1
- 10,000 known species of commensals
- Each of us have between 200-1000 sp.
- Most cannot be cultured

Microbiota = Bacteria Viruses Fungi

Lung Microbiota

Human Microbiome: Microbial GENES
http://unlockinglifescode.org/explore/genomic-medicine/microbiome
Phylum | Selected Species
---|---
Actinobacteria | Bifidobacterium spp.
Firmicutes | Lactobacilli spp.
 | Bacillus spp.
 | Lactococcus spp.
 | Lachnospiraceae
 | Candidatus savagella
Bacteroidetes | Bacteroides spp.
 | Prevotella spp.
Proteobacteria | Helicobacter spp.
 | Bilophila wadsworthia
 | Vibrio cholerae


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**Microbiome & Health**

Cardiovascular
Autoimmune Disease
Nerve Health
Skin
Weight Management
Pain
Glucose Metabolism
Digestive Health
Mental Health
Child Behavior
Stress
Atopy
“Many human genes are homologs of bacterial genes.... The word commensal is derived from the Latin term “cum mensa”, which means “eating together”.... We are fundamentally dependent on a myriad of essential neurochemicals produced by microbes.”

Timothy Dinan, Roman Shilling, Catherine Stanton, Jon Cryan


Microbiome & the Gut-Brain Axis

- Germ Free Mice: Gut Microbiota affects
  - Anxiety
  - Learning & Memory
  - Mental Health & Mood
  - Appetite and Satiety
  - Autistic behavior
  - Neurological disorders such as MS, Parkinson's

Mazmanian, Hsiao, et al.

Anxiety and Depression people with GI Diseases

- 1641 patients from GI practices
- 84.1% state anxiety
- 67% trait anxiety
- 27% depression


Psychiatric Comorbity with IBS

- IBS in 10-20% of US adult population
- 70-90% of patients with IBS who seek treatment have psychiatric comorbity: mainly mood and anxiety disorders.
- 19% IBS in schizophrenia
- 29% IBS in major depression
- 46% IBS in panic disorder

Mental Disorders and Celiac in Adolescents

29 teens with celiac/29 teen controls
• 31% vs 7% major depressive disorder
• 28% vs 3% disruptive behavior disorders
• Typically these Diagnoses preceded the diagnosis of celiac disease.


Schizophrenia and The Gut

• 5.5% high levels of anti-gliadin antibodies
• 2.6-4.2% meet criteria for celiac disease
• 10% improve on GF diet
• Dohan: 62% of men on GF/CF diet improved in an inpatient setting
• Casein: > bioactive brain peptides yet < severity of episodes when H. pylori is present
• > IgG to Anti-Saccharomyces cervisiae antibodies, casein, gluten, and 6 infections in people with schizophrenia
• > IgA to gliadin, beta-lactoglobulin and casein

Neurological Issues in Celiac

• 72 people with celiac disease
• Migraine (28%)
• Carpal tunnel syndrome (20%)
• 35% reported hx of psychiatric disease: depression, personality changes, or even psychosis
• 35% deep sensory loss


Gluten Sensitivity and the Brain

• 57% positive antigliadin antibodies in people with neurological issues (12% in controls)
• Ataxia, neuropathy, epilepsy, myopathy, myelopathy

Hadjivassiliou M. Dig. Dis. 2015;10(2):164-8; Catassi (2013) Nutrients S, 3839-3853

How Microbes Shape Human Behavior


Efferent & afferent. Anti-inflammatory

Does your microbiome tell you what to eat?

Aktipis, A. USCF news.edu/2014/08/116526/dog-gut-bacteria-rule-our-minds
Psychobiotic

“We define a psychobiotic as a live organism that, when ingested in adequate amounts, produces health benefits in patients suffering from a psychiatric illness. As a class of probiotic, these bacteria are capable of producing and delivering neuroactive substances such as gamma-aminobutyric acid and serotonin, which act on the brain-gut axis.”


<table>
<thead>
<tr>
<th>Microbe</th>
<th>Neurotransmitter</th>
<th>Depression/Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>L. rhamnosis</td>
<td>GABA</td>
<td>X</td>
</tr>
<tr>
<td>B. infantis</td>
<td>Norpinephrine</td>
<td>X</td>
</tr>
<tr>
<td>L. helviticus &amp; B. longum</td>
<td>norpinephrine</td>
<td>X</td>
</tr>
<tr>
<td>L. casei</td>
<td>GABA</td>
<td></td>
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<tr>
<td>Lactobacilli</td>
<td>GABA</td>
<td></td>
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<tr>
<td>Bifidobacteria</td>
<td>GABA</td>
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<tr>
<td>Escherichia</td>
<td>Norpinephrine, Serotonin</td>
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<tr>
<td>Saccharomyces</td>
<td>Norpinephrine</td>
<td></td>
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<tr>
<td>Spore forming microbes</td>
<td>Serotonin</td>
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<tr>
<td>Enterococcus</td>
<td>Serotonin</td>
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<tr>
<td>B. breve</td>
<td>Norpinephrine, Serotonin</td>
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</tbody>
</table>

Microbes Neurotransmitter Depression/ Anxiety Cortisol/ Stress

Leaky Gut = Leaky Brain

- Mental Disorder
- Mood swings
- Nervousness
- Aggressive Behavior
- Fatigue/Malaise
- Poor memory/concentration
- Confusion

- Food & Environmental Sensitivities
- Addictive Behavior

Probiotics and Mental Health

- Women: fermented milk: b. animalis (Lactis), S. thermophiles, L. bulgaricus, Lactococcus lactis 4 wks: Global enhancement on brain function. (no change in placebo group)
- Lactobacilli and Bifidobacterium < Post MI depression
- Mechanism: < inflammatory cytokines, regulation of tryptophan metabolism, and neurotransmitters, healthier gut barrier

Probiotics Improved HPA Axis and Mental Health

- 70 petrochemical workers
- Randomized for 6 weeks
  - Placebo + probiotic yogurt,
  - Probiotic capsule + 100 gms commercial yogurt
  - Placebo + 100 gms commercial yogurt
- Improved: in Probiotic yogurt and probiotic groups: general health questionnaires, mental health and stress

Mohammadi AA. Nutr Neurosci. 2015 Apr 16.


What Affects your Microbiota

- Sex
- Age
- Diet
- Stress
- Geography
- Ethnicity
- Family
- Probiotics
- Prebiotics
- Method of birth
- Breast fed or bottle fed
- Medications/Antibiotics
- Lifestyle
Putting this into Action: In Good Health

Diet and Microbiome

“Diet has the most powerful influence on gut microbial communities in healthy human subjects.”

About 75% of the food in the Western diet is of limited or no benefit to the microbiota in the lower gut. Most of it, comprised specifically of refined carbohydrates, is already absorbed in the upper part of the GI tract, and what eventually reaches the large intestine is of limited value, as it contains only small amounts of the minerals, vitamins and other nutrients necessary for maintenance of the microbiota.

Bengmark S. “Nutrition of the Critically Ill: a 21st-Cent perspective”
Nutrients 2013, 5, 162-207

Eating at least seven daily portions was linked to a 42% lower risk of death from all causes and from cancer and heart disease/stroke of 25% and 31%, respectively, after excluding deaths within the first year of the monitoring period.


Polyphenols in food promote growth of Probiotic microbes

- Green tea
- Red wine
- Apples
- Onions
- Chocolate
- Panax ginseng
- > Lactobacilli
- > Bifidobacteria
- < pathogens

Spices:
Dried: 1-3 tsp daily
or
Fresh: 1-3 TBSP daily
**Probiotic Rich Foods**

- Yogurt/Kefir
- Miso
- Natto
- Tempeh
- Sauerkraut
- Kim chee
- Raw pickles
- Fermented anything
- Root and ginger beers
- Olives
- Honey
- Pulke
- Kombucha
- Fermented vegetables
- Buttermilk
- Raw whey
- Raw vinegars
- Fermented sausages
- Sourdough
- Essene bread
- Beer
- Wine

**Prebiotics**

- Jerusalem artichokes
- Onions
- Chicory
- Garlic
- Leeks
- Bananas
- Fruit
- Soybeans
- Burdock root
- Asparagus
- Maple syrup/sugar
- Chinese chives
- Peas
- Legumes
- Eggplant
- Honey
- Green Tea
- Yogurt, cottage cheese, kefir

**SCFA Production in Colon**

<table>
<thead>
<tr>
<th>Prebiotic Foods</th>
<th>Bacterial Enzymes</th>
<th>SCFA</th>
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<tbody>
<tr>
<td>Jerusalem artichokes</td>
<td>Bifidobacteria</td>
<td>Bifidobacteria</td>
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<td>Onions</td>
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<td>Chicory</td>
<td>Propionic</td>
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<td>Garlic</td>
<td>Valeric</td>
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<td>Leeks</td>
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<td>Bananas</td>
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<td>Fruit</td>
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<td>Soybeans</td>
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<td>Burdock root</td>
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<td>Asparagus</td>
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**GI Healing Diets**

- Enhance digestion and absorption
- Reduce inflammation
- Hypoallergenic (restricts proteins)
- Balance microbiota
- Heals a Leaky Gut
- Often limited to specific types of carbohydrates
- Reduces toxic burden
GI Healing Diets

- FODMAP Diet
- Gluten Free/Dairy Free Diet
- Specific Carbohydrate Diet
- GAPS Diet
- Anti-Candida Diet
- Rotation Diet
- Elemental Diet/Polymeric Diet
- Low Histamine or Oxylate
- Whole Foods Diet
- Restorative Diet

Resources:

- Robynne Chutkan MD, Microbiome Solution
- Raphael Kellman MD, The Microbiome Diet
- Gerard E. Mullin, MD, Gut Balance Revolution
- Kathie Swift, MS, RD, The Swift Diet
- Tom Malterre, MS, CNS/A. Segersten, The Elimination Diet, Whole Life Nutrition Cookbook
- Sue Sheppard/Peter Gibson, www.FODMAP.com
  The Complete Low FODMAP DIET
- Donna Gates, Body Ecology Diet
- Natasha Campbell McBride, MD: Gut & Psychology Syndrome
- Elaine Gotschall PhD, Breaking the Vicious Cycle
  www.breakingthevisciouscycle.info. Breaking the Viscous Cycle, Grain-Free Gourmet

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