Food and Mood
A Nutritionist’s Look at the Brain-Gut Connection
And Ways We Can Impact It

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Today’s Learning Objectives
- Build understanding of how communication occurs between the brain and the gut
- Discover ways diet can influence mood and mental health
- Consider how nutrient deficiency can alter mental health and mood
- Identify some pitfalls in contemporary nutrition messages

How does Information Travel between the Brain and Gut?

Main channels of Communication:
- Circulatory System/Blood
  - Hormones
  - Gut Peptides
- Nervous System/Nerve Impulses and Neurotransmitters
  - Dopamine
  - Serotonin
  - Others

WHAT IS MOOD?
- Possible definitions:
  1. The way you feel at a particular time or at a given moment
  2. A conscious state of mind or predominant emotion
  3. In mental health or clinical settings, it is used to describe a persistent (or sustained, pervasive, etc.) emotional state that affects a person’s perception or how they see the world
  4. Influenced by both internal and external factors

How Diet Affects Mood and Mental Health

- Bully more for a brain!
**Routes of Communication**

**Endocrine System and Hormonal Signaling**
- Origination sites
- Types
- Speed of signaling
- Insulin and glucagon are produced in the pancreas
- Leptin is produced by fat cells
- Transported via circulatory system (i.e., blood stream)
- Cross the blood-brain barrier to affect areas of the brain, especially the arcuate nucleus (ARC) of the hypothalamus
- Slower acting than nerve impulses

**Fat Cells**
- (a.k.a., adipocytes)
- Not just passive storage vessels for triglycerides (energy)
- Play a role in hormonal regulation of appetite and satiety
- Produc leptin, which acts upon areas of the brain and interacts with other hormones

**Routes of Communication continued...**

**Gut Peptides**
- Examples include Ghrelin, Cholecystokinin (CCK), PYY, GLP-1
- Produced in various areas of the gut, such as the stomach and parts of the small intestine
- Similar to hormones, carried via blood stream to the brain
- Affect the hypothalamus and other areas associated with satiety and reward

**Routes of Communication continued...**

**Gut Peptides continued...**
- E.g., stretch (tension) and density receptors in stomach
- Vagus nerve
- Speed of signaling
- Neurotransmitters
  - Dopamine
  - Serotonin

**Routes of Communication continued...**

**Vagus Nerve**
- Longest of the cranial nerves (10th), running from brainstem to colon
- Carries both afferent and efferent messages
- Commands unconscious (autonomic) body procedures, including:
  - Heart rate
  - Respiration
  - Gastrointestinal peristalsis
  - Secretion of gastric juices
  - Some mouth movements
- Plays a role in satiation

**How Diet Affects Mood and Mental Health**
1. Blood Sugar Balance
2. Hydration
3. Nutrients of Special Relevance, Deficiency, & Brain Health
How can Diet Affect One’s Mood and Mental Health?

1. Blood Sugar Balance
2. Hydration
3. Nutrients of Special Relevance, Deficiency, & Brain Health

Hypoglycemia (low BG) Signs and Symptoms include:
- Shakiness
- Sweating
- Dizziness
- Hunger
- Blurry vision
- Increased heart rate (tachycardia)
- Headache
- Annoyance/Nervousness
- Weakness, tremors, or fatigue
- Irritability, even anger
- Low energy = apathy, sadness, hopelessness

Blood Sugar (Glucose) Control imbalance:
1. Skipped meals and snacks
   - >4 hours between meals
   - >2 hours between snacks (AM, PM, H.S.)
   - No breakfast
2. Simple/refined carbohydrates
   - Absorbed into bloodstream quickly
   - Initial 'high' or BG surge followed by proportional insulin response and 'crash'
   - Lends to a cycle of sugar-seeking
   - Sources include sugar-sweetened beverages and sweet, dessert-type foods, like, pastries, cookies, cakes, and candies;
   - Other sources are refined grains (white) flours, as in bread and pasta, and fruit juices
   - Processed/prepared foods
3. Lack of protein foods
   - Results in lowered satiety
   - Absorption of carbohydrates is further expedited, resulting in a higher 'glycemic index' of food (and higher post-prandial blood glucose level)

Blood Sugar (Glucose) Control balance:
1. Regular meals and snacks
   - Every 2-4 hours
   - 2 small meals and snacks
   - Before bedtime snack promotes overnight BG maintenance, especially if proteins, fiber, and leaner meat/fish are included
2. Complex carbohydrates
   - Metabolized (and absorbed into bloodstream) more slowly
   - Fiber serves as a blood glucose 'buffer' of sorts
   - Often higher in micronutrients, such as B vitamins and zinc
   - Sources include wholegrain breads, rice, pasta, and cereals; nuts, seeds, beans and lentils, and fruits and vegetables
3. Protein base to meals and snacks, and fat "partners"
   - Protein, and to some extent fats, help to slow the uptake carbohydrates (lowering glycemic index)
   - High satiety effect
   - Fats slow GI motility

Dehydration Signs and Symptoms include:
- Increased thirst
- Dry, sticky mouth
- Dry, cool skin that doesn’t bounce back
- Swollen tongue, sunken eyes
- Weakness, sleepiness
- Dizziness/lightheadedness, and fainting
- Palpitations (feeling that the heart is jumping or pounding)
- Inability to sweat
- Decreased urine output, little to no tears (when crying), and constipation
- Muscle cramping
- Muscle cramping
- Weakness, dizziness, and fainting
- Headache and fever (extreme)
- Muscle cramping
- Increased body temperature
- Difficulty paying attention, concentrating, remaining alert
- Fussiness and sleeplessness (infants)
Children

**Data (for Children) are from Institute of Medicine of the National Academies.**

**Dietary Reference Intakes (DRIs) Tables.**

**Recommended Daily Allowance and Adequate Results in an intake of 8-10 (8oz.) cups/day for most adults.**

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**III. What roles do these compounds play in the body?**

<table>
<thead>
<tr>
<th>Neurotransmitter</th>
<th>Effects of Deficiency</th>
<th>Foods to avoid</th>
<th>Foods to consume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetylcholine</td>
<td>Determined memory and imagination. Frequent dreams. Scared, confused, forgetful, and disoriented.</td>
<td>Alcoholic drinks</td>
<td>Olive or sunflower oil, fish, eggs, and whole grains.</td>
</tr>
<tr>
<td>Dopamine</td>
<td>Lack of drive, motivation, and enthusiasm. Curing stimulants.</td>
<td>Yeast, coffee, and caffeine</td>
<td>Foods high in fiber, such as whole grains.</td>
</tr>
<tr>
<td>GABA</td>
<td>Hard to relax. Can't focus or study. Anxiety, irritability, self-criticism.</td>
<td>Sugar, alcohol, and caffeine</td>
<td>Dark green vegetables, seeds, and nuts.</td>
</tr>
</tbody>
</table>

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**3. Nutrients of Special Relevance to Mood and Mental Health**

**Amino Acids**

- Building blocks of proteins and all bodily tissues, including neurotransmitters (e.g., serotonin, dopamine, norepinephrine, and GABA).
- Some are essential (must be eaten since the body cannot make them), others are nonessential (bodies can synthesize from other amino acids).
- Tyrosine → dopamine
  - Dopamine is made from tyrosine. Dopamine deficiency is associated with reduced drive, motivation, and enthusiasm and can lead to cravings for stimulants.

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**3. Nutrients of Special Relevance to Mood and Mental Health**

**Essential fatty acids:**

- Linoleic acid (LA) → arachidonic acid

**B. Alpha-linolenic acid (ALA) → eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA):**

- Vegetable oils (and the seeds or nuts they derive from)
- Grain-fed meats
- Sunflower
- Canola
- Rapeseed
- Others (shrimp, krill, aquatic plants, etc.)

**C. Deficiency and/or imbalance:**

- Serum values: can lead to a reduced drive, motivation, and enthusiasm, and can lead to cravings for stimulants.

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**3. Nutrients of Special Relevance to Mood and Mental Health**

**3. Nutrients of Special Relevance to Mood and Mental Health**

**A. Omega-3 Fatty Acid**

1. Linoleic acid (LA) → arachidonic acid
2. Food sources include:
   a. Vegetable oils
   b. Grain-fed meats
   c. Sunflower
   d. Canola
   e. Rapeseed
   f. Others (shrimp, krill, aquatic plants, etc.)

**B. Alpha-linolenic acid (ALA) → eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA):**

1. Food sources include:
   a. Fatty, cold-water fish and their oils
   b. Some vegetable oils (and the seeds or nuts they derive from)
   c. Green leafy vegetables
   d. Infant formulas and dairy products
   e. Wild game, pasture-raised and grass-fed meats, milks, and eggs

**C. Deficiency and/or imbalance:**

- Fish are agricultural times:
  1. EPA vs. DHA
  2. Essential fatty acids (EFA's)
  3. Supplementation may improve symptoms:
     a. Fall off the most common form
     b. Must safeguard against mercury contamination by seeking wild caught fish
     c. Relatively low in temperature and light instability
     d. How the fish are harvested and handled can impact the quality of the oils

**D. Supplements are needed to confirm these relationships:**

- In general, supplements do not reliably increase long-term disease outcomes/risk
- Food sources remain superior, and safer.
3. Nutrients of Special Relevance to Mood and Mental Health

**Antioxidants**

- Phytochemicals that ‘disarm’ toxins, decreasing brain pollution (free radicals that lead to oxidation)
- Reduce inflammation
- Most significant sources are foods, esp. fruit and vegetables
- Some examples include vitamins A, C, and E
- Plant pigments are also important antioxidants

**Antioxidant Pigments**

<table>
<thead>
<tr>
<th>Color</th>
<th>Phytochemical</th>
<th>Fruit and Vegetable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Chlorophyll</td>
<td>broccoli, kale</td>
</tr>
<tr>
<td></td>
<td>Glucosinolates</td>
<td></td>
</tr>
<tr>
<td>Orange</td>
<td>α- and β-carotene</td>
<td>carrot, mango, pumpkin</td>
</tr>
<tr>
<td>Red</td>
<td>Lycopene</td>
<td>tomato</td>
</tr>
<tr>
<td>Red-purple</td>
<td>Anthocyanins</td>
<td>grapes, blackberries, raspberries, blueberries</td>
</tr>
<tr>
<td>Orange-yellow</td>
<td>Flavonoids</td>
<td>honeymede melon, peach, papaya, orange, ginger</td>
</tr>
<tr>
<td>Yellow-green</td>
<td>Lutein and zeaxanthin</td>
<td>spinach, corn, avocado, melon</td>
</tr>
</tbody>
</table>

**Antioxidants continued...**

- Tips to increasing intake:
  1. Seek a variety of foods from fruit and vegetable groups to ensure an array of vitamins and pigments are ingested
  2. Seek fresh and minimally-processed produce that has not been heat-denatured or exposed to time, light and heat
  3. Consider:
     - Exposure to time, heat, and light
     - Method of preparation
     - Food ‘pairing’

3. Nutrients of Special Relevance to Mood and Mental Health

**Vitamin D**

- Seems to play a role in immunity
- Protects against DNA damage
- Repairs DNA damage once it has occurred
- Reduces oxidative stress
- Non-essential due to body’s ability to synthesize via sunlight exposure
- Deficiency is implicated in various mood disorders, including depression, seasonal affective disorder (SAD), and premenstrual syndrome (PMS).
- Supplementation may improve symptoms
- Further research is needed (and already underway) to clarify the effects of this vitamin on mental health/illness and mood
- Use caution and speak with a doctor before taking mega doses of supplemental vitamin D

**Sources of Vitamin D**

- Fortified foods, especially milk and other dairy products, as well cereals and juices
- Fatty fish, and their oils
- Egg yolk
- Mushrooms
- Sunshine
- Supplements

3. Nutrients of Special Relevance to Mood and Mental Health

**B Vitamins**

- Involved in energy production, cell division, and overall health
- Important in fetal brain and spinal cord development
- Key examples: Thiamine, Folic Acid (Folate), Vitamin B12, Niacin

**Probiotics**

- Influence gut health by influencing the gut flora (bacterial cultures in the small and large intestines that are involved with digestion, absorption and other metabolic processes)
- Can reduce inflammation
- Can treat IBS
- Can improve symptoms of depression

3. Nutrients of Special Relevance to Mood and Mental Health
4. COMMON PITFALLS IN NUTRITION INFORMATION

1. Reductionist view of nutrients
2. Compartmentalization of body systems
   - mind vs. body
3. More = better view
   - versus moderation, variety, balance
   - In regards to supplementation

Thank You for Your Interest and Attention!

Questions?

Please email further comments and inquiries to Andrew.Mader@dhs.wisconsin.gov