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

Andrew Mader, DTR
Andrew.Mader@dhs.wisconsin.gov
Thursday, February 23rd, 2017

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?

1. Possible definitions:
   a. the way you feel at a particular time or in a given moment
   b. a conscious state of mind or predominant emotion
   c. 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 of how they see the world

   Mood is influenced by both internal and external factors, including genetic dispositions, upbringing, culture, personal experiences, current events, and personal health status, among other things.

   How Diet Affects Mood and Mental Health
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)
1) Not just passive storage vessels for triglycerides (energy)
2) Play a role in hormonal regulation of appetite
3) Produce leptin, which acts upon areas of the brain and interacts with other hormones

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...

Neurological System and Neural Signaling
• Efferent vs. Affluent Nerves
  - e.g., stretch (tension and density receptors in muscles)
  - Vagus nerve
• Speed of signaling
• Neurotransmitters
  - Dopamine
  - Serotonin

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

2. Hydration

3. Nutrients of Special Relevance, Deficiency, & Brain Health


BLOOD SUGAR BALANCE

*Graphs indicate instances of low blood glucose (hypoglycemia).*
*Fluctuations in graph indicate instances of high blood glucose (hyperglycemia).*
Blood Sugar (Glucose) Control

Imbalance

1. Skipped meals and snacks
   - *6 hours between meals
   - *6 hours between snacks (AM, PM, B.L.)
   - No breakfast
2. Simple/refined carbohydrates
   - Absorbed into bloodstream quickly
   - Initial 'high' or BG surge followed by proportional insulin response and 'crash'
   - Leads 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 bread, rice, 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 levels.

Blood Sugar (Glucose) Control

Balance

1. Regular meals and snacks
   - Every 2-4 hours
   - 6 small meals an option
   - Bedtime (H.S.) snacks promote overnight BG maintenance, especially if protein, fiber, and healthy (unsaturated) fats 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, lentils (and peas), 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 of carbohydrates (lowering glycemic index)
   - High satiety effect
   - Fats slow GI motility

How can Diet Affect One’s Mood and Mental Health?

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

Dehydration Signs and Symptoms include:

- Increased thirst
- Dry, sticky mouth
- Dry, cool skin that doesn’t bounce back
- Swollen tongue, sunken eyes
- Weakness, 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
- Headache and fever (extreme)
- Muscle cramping
- Sluggishness/lethargy
- Restlessness
- Confusion and irritability (Adults)
- Difficulty paying attention, concentrating, remaining alert
- Fussiness and sleeplessness (Infants)
### Fluid Recommendations

**Adults**
- Daily needs:
  - 30cc (mL) of body weight or 0.4 oz. per pound body weight
- Results in an intake of 8-10 (8oz.) cups/day for most adults

**Children**

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Gender</th>
<th>Total Water (Cups/Day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 to 8 yrs</td>
<td>Girls and Boys</td>
<td>5</td>
</tr>
<tr>
<td>9 to 13 yrs</td>
<td>Girls</td>
<td>7</td>
</tr>
<tr>
<td>14 to 18 yrs</td>
<td>Boys</td>
<td>8</td>
</tr>
</tbody>
</table>

---

### 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, noradrenaline, and GABA)
- Some are essential must be eaten since the body cannot make them, others are nonessential (body can synthesize from other amino acids)
- **Tryptophan → serotonin**
  - In the body, tryptophan is a precursor to serotonin
  - Serotonin deficiency is associated with low mood/depression, difficulty sleeping, feelings of disconnect and reduced joy
- **Tyrosine → dopamine**
  - Dopamine is made from tyrosine
  - Dopamine deficiency is associated with reduced drive, motivation, and enthusiasm and can lead to cravings for stimulants

#### Neurotransmitters

<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>Deterioration of memory and imagination, Faintness, Confusion, Fatigue, and Forgetfulness.</td>
<td>Sugar, Dried Fruit, Refined and processed foods.</td>
<td>Organic, free-range eggs, Fish, fresh fish.</td>
</tr>
<tr>
<td>Dopamine</td>
<td>Lacking drive, motivation, and/or enthusiasm. Caring, sharing.</td>
<td>Tea and coffee.</td>
<td>Dark green vegetables, Seeds and nuts.</td>
</tr>
<tr>
<td>GABA</td>
<td>Hard to relax, Can't sleep well. Anxious about doing, feeling. Self-critical.</td>
<td>Sugar, Alcohol, Tea and coffee.</td>
<td>Dark green vegetables, Sea foods.</td>
</tr>
</tbody>
</table>
3. Nutrients of Special Relevance to Mood and Mental Health

Essential fatty acids

I. Omega-3 Fatty Acids

A. Alpha-linolenic acid (ALA) -> eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA)

B. Food sources include:
   a. fatty, cold-water fish and their oils
      - mackerel
      - sardine
      - salmon
      - tuna
      - others (shrimp, krill, aquatic plants, etc.)
   b. some vegetable oils (and the seeds or nuts they derive from)
      - flaxseed
      - canola
      - peanut
      - walnut
      - chia
   c. green leafy vegetables
   d. infant formulas, fortified milk and eggs
   e. wild game, pasture-raised and grass-fed meats, milks, and eggs

II. Why are they essential?

A. Determine the brain’s integrity and ability to perform

B. Can not be synthesized by the body

1. LA and ALA must be obtained from dietary sources

2. EPA, DHA, and arachidonic acid formed in body from “parent” FA’s/EFA’s

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

A. Components of cell membranes
   1. neuronal membrane (approx. 50% FA’s)
   2. myelin sheath (approx. 70% FA’s)

B. Form precursors to neurochemicals involved in brain’s blood flow, the immune system, and the neurotransmitter system

3. Nutrients of Special Relevance to Mood and Mental Health

Essential fatty acids continued…

IV. Balance of Omega-3 vs. Omega-6 Fatty Acids

A. Ratio has shifted significantly since ancient times

1. estimated to be 1:1 (pre-agricultural times?)

2. current ratios estimated to be 15:1 to 17:1

3. recommended ratio is 6:1

B. ‘Seeds vs. Leaves’ theory (Pollan)

C. Deficiency and/or imbalance may be implicated in depression, autism, and other mental illnesses

1. Supplementation may improve symptoms

   a. fish oil the most common form

   b. must safeguard against mercury contamination by seeking trustworthy suppliers

   c. refrigerate due to temperature (and light) instability

   d. how the fish are harvested/handled and processed changes the quality of the oil

   e. more research is needed to confirm these relationships

   f. in general, supplements do not reliably reduce long-term disease outcomes/risk

   g. food sources remain superior, and safer
3. Nutrients of Special Relevance to Mood and Mental Health

Antioxidants

1. Phytochemicals that ‘disarm’ toxins, decreasing brain pollution (free radicals that lead to oxidation)
2. Reduce inflammation
3. Most significant sources are foods, esp. fruit and vegetables
4. Some examples include vitamins A, C, and E
5. 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>honeydew melon, peach, papaya, orange, tangerine</td>
</tr>
<tr>
<td>Yellow-green</td>
<td>Lutein and zeaxanthin</td>
<td>spinach, corn, avocado, melon</td>
</tr>
</tbody>
</table>

**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 (whole foods vs. prepared or refined options)
3. Consider:
   - exposure to time, heat, and light
   - method of preparation
   - food ‘pairing’

3. Nutrients of Special Relevance to Mood and Mental Health

ANTIOXIDANT PIGMENTS
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 effect 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 yolks
- Mushrooms?
- Sunshine
- Supplements

B Vitamins
- Probiotics

3. Nutrients of Special Relevance to Mood and Mental Health

Influence gut flora, which
- produce certain nutrients, including Vitamin K, some B vitamins (B12), and fatty-acids
- Influence neurological function in the nervous system

Inoculation
Re-inoculation
‘Crowding out’ Concept
Probiotics
Human microflora
Health and function

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 regard to supplementation

Thank You for Your Interest and Attention!

Questions?

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