Food and Mood
A Nutritionist’s View of the Brain-Gut Connection and Ways We Can Promote Recovery through Diet
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Today’s Learning Objectives
1. Develop greater understanding of how communication between the brain and the gut occurs.
2. Discover ways diet can influence mood and mental health.
3. Consider the nutritional risks of substance use, and ways diet can influence recovery.
4. Identify some pitfalls in contemporary nutrition messages.

How Information Travels between the Brain and Gut
Main Channels of Communication:
- Circulatory System: Blood
  - Hormones
  - Gut Peptides
- Nervous System: Nerve Impulses and Neurotransmitters
  - Dopamine
  - Serotonin
  - Others
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 and regulate the storage and retrieval of nutrients, like blood glucose and some neurotransmitters.

Leptin is produced by fat cells and transported via the circulatory system (i.e., bloodstream).

Cross the blood-brain barrier to affect areas of the brain, especially the arcuate nucleus (ARC) of the hypothalamus.

Slower acting than nerve impulses.

Interplay between hormones.

Fat Cells
(a.k.a., adipocytes)
1. Not just passive storage vessels for triglycerides
2. Play a role in hormonal regulation of appetite and satiety
3. Produce leptin, which acts upon areas of the brain and interacts with other hormones and gut peptides
**Routes of Communication continued...**

**Gut Peptides**
- Examples include Ghrelin, Cholecystokinin (CCK), PYY, GLP-1
- Produced in various areas of the gut, particularly the stomach and portions 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
- With the exception of ghrelin, as the gut peptides reach the brain, satiety is experienced and hunger decreases; ghrelin levels increase as time between increases

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**Routes of Communication continued..**

**Neurological System and Neural Signaling**
- Efferent vs. Afferent Nerves
  - Example: stretch (tension) and density receptors in stomach
  - Vagus nerve
- Speed of signaling
- Neurotransmitters
  - Dopamine
  - Serotonin
  - Others

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**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
  - Release of gastric juices
  - Some mouth movements
- Plays a role in satiety
How Diet Affects Mood and Mental Health

1. Blood Sugar Balance
2. Hydration
3. Nutrients of Special Relevance to Mood and Mental Health (and Deficiency)
4. Promoting Recovery Through Diet
5. Common Misperceptions/Pitfalls in Nutrition Dialogue

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

1. Blood Sugar Balance
2. Hydration
3. Nutrients of Special Relevance to Mood and Mental Health (and Deficiency)
4. Promoting Recovery Through Diet
5. Common Misperceptions/Pitfalls in Nutrition Dialogue

Hypoglycemia (low BG) 
Signs and Symptoms include:
- Shakiness
- Sweating
- Dizziness
- Hunger
- Blurry vision
- Increased heart rate (tachycardia)
- Headache
- Nervousness, restlessness
- Weakness, tiredness, or fatigue
- Irritability, anger
- Lack of motivation
- Low energy = apathy, sadness, hopelessness
- CRAVING (for food, drugs, alcohol?)

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

1. Blood Sugar Balance
BLOOD SUGAR BALANCE

Markers of Blood Sugar (Glucose) Imbalance

1. Skipped meals and snacks
   - >4 to 5 hours between meals
   - >2 hours between snacks (AM, PM, H.S.)
   - No breakfast

2. Simple/refined carbohydrates
   - Absorbed into bloodstream rapidly
   - Initial 'high' or BG surge followed by proportional insulin response and 'crash'
   - May lead to cycle of sugar-seeking: reward centers of the brain adjust to surges in BG and the "pleasure threshold" is increased
   - Sources include sugar-sweetened beverages (e.g., sodas, teas, energy drinks and juices, desserts, fruits, candy, cakes, and cereals)
   - Other sources are refined grains (white) or processed foods like bread, pasta, and fruit juices
   - Processed foods tend to lower sugar amounts of simple carbohydrates

3. Lack of protein-rich foods
   - Less satiety achieved
   - Absorption of carbohydrates is expedited, resulting in a higher 'glycemic index' of food and higher post-prandial blood glucose levels

Markers of Blood Sugar (Glucose) Balance

Indicators include:

1. Regular meals and snacks
   - Every 2-4 hours
   - '6 small meals' option
   - Bedtime (H.S.) snacks promote overnight BG maintenance, especially when protein, fiber, even fat, are included

2. Complex carbohydrates
   - Metabolized slowly, absorbed into bloodstream more slowly
   - Fiber serves as a blood glucose "buffer" of sorts
   - Other sources include whole grains, beans, nuts, seeds, lentils, and fruits and vegetables

3. Protein base to meals and snacks; add fat "partners"
   - Protein, and to some extent fat, help to slow down carbohydrates and limit BG peaks, protecting glucose index
   - High satiety effect
   - Fat aids GI health
How can Diet Affect One’s Mood and Mental Health?

1. Blood Sugar Balance
   - Dehydration Signs and Symptoms include:
     - Increased thirst
     - Dry, sticky mouth
     - Weakened immune system
     - Fatigue
     - Headaches
     - Confusion and irritability
     - Difficulty paying attention, concentrating, remaining alert: disorientation
     - CRAVING for food, drugs, alcohol?

2. Hydration
   - Dehydration Signs and Symptoms include:
     - Increased thirst
     - Dry, sticky mouth
     - Dry, cool skin that doesn’t bounce back
     - Weakened immune system
     - Fatigue
     - Headaches
     - Confusion and irritability
     - Difficulty paying attention, concentrating, remaining alert: disorientation
     - CRAVING for food, drugs, alcohol?

3. Nutrients of Special Relevance to Mood and Mental Health
   - Amino Acids
     - ‘Building blocks’ of proteins and all bodily tissues, including neurotransmitters
     - Serotonin
     - Dopamine
     - Nor-adrenaline (nor-epinephrine)
     - GABA
     - Some are essential (must be eaten since the body can not make them)
     - Others are non-essential or conditionally essential (body can synthesize from other amino acids in most circumstances)
     - Proper levels of NT’s are necessary to mental clarity, emotional stability, a general state of wellbeing
     - Drug and alcohol cravings are due to malfunctions of reward centers of the brain involving NT’s and the enzymes that control them
     - Supplementation may reduce anxiety, depression, stress response
     - increase glucose and neurotransmitter receptor sensitivity
     - restore neurotransmitter levels in the brain

4. Promoting Recovery Through Diet

5. Common Misperceptions/Pitfalls in Nutrition Dialogue

Fluid Recommendations

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Total Daily Beverage and Drinking Water Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>5 cups/day</td>
</tr>
<tr>
<td>Girls</td>
<td>5 cups/day</td>
</tr>
<tr>
<td>6 to 8 yrs</td>
<td>5 cups/day</td>
</tr>
<tr>
<td>9 to 13 yrs</td>
<td>7 cups/day</td>
</tr>
<tr>
<td>14 to 18 yrs</td>
<td>8 cups/day</td>
</tr>
<tr>
<td>Girls</td>
<td>11 cups/day</td>
</tr>
<tr>
<td>Boys</td>
<td>11 cups/day</td>
</tr>
</tbody>
</table>

Results in an intake of 8-10 (8oz.) cups/day for most adults
3. Nutrients of Special Relevance to Mood and Mental Health

Amino Acids continued...

- Tryptophan → serotonin
  - Must be obtained via diet (essential nutrient)
  - In the body, tryptophan is a precursor to serotonin
  - Vitamin B6 and magnesium play critical roles in this conversion
  - Serotonin deficiency is associated with low mood/depression, difficulty sleeping, feelings of disconnect, and reduced joy
  - Serotonin has a calming effect
  - 95% of serotonin is located in specialized cells in the gut

- Tyrosine → dopamine, also nor-epinephrine
  - Tyrosine can be synthesized from phenylalanine, another AA; in other words it is non-essential/conditionally-essential
  - Dopamine and nor-epinephrine are made from tyrosine
  - Dopamine deficiency is associated with reduced drive, motivation, and enthusiasm and can lead to cravings for drugs and alcohol

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<table>
<thead>
<tr>
<th>Neurotransmitter</th>
<th>Effect 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, forgetfulness, reduced concentration, and disorganization.</td>
<td>Sugar, Deep-fried foods, Refined and processed foods, Cigarettes, Alcohol</td>
<td>Organic/free-range eggs, Organic or wild fish, especially salmon, mackerel, sardines, and fresh tuna</td>
</tr>
<tr>
<td>Dopamine</td>
<td>Lacking drive, motivation, and/or enthusiasm. Craving stimulants.</td>
<td>Tea and coffee, Caffeinated drinks and pills</td>
<td>Regular, balanced meals, Fruits and vegetables high in Vitamin C, Whole grains, Yeast spreads</td>
</tr>
<tr>
<td>GABA</td>
<td>Hard to relax. Can’t switch off. Anxious about things. Irritable, Self-critical</td>
<td>Sugar, Alcohol, Tea and coffee</td>
<td>Dark green vegetables, Seeds and nuts, Potatoes, Bananas, Eggs</td>
</tr>
</tbody>
</table>

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3. Nutrients of Special Relevance to Mood and Mental Health

Essential fatty acids

1. Obtained in polyunsaturated fatty acids (PUFA)
2. Omega-3 Fatty Acids
   - Alpha-linolenic acid (ALA) → eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA)
   - 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
3. Nutrients of Special Relevance to Mood and Mental Health

II. Omega-6 Fatty Acid

1. Linoleic acid (LA) -> arachidonic acid

2. Food sources include:
   a. vegetable oils (e.g., olive, sunflower, safflower, corn)
   b. grain-fed meats

II. Why are they essential?

A. Determine the brain's integrity and ability to perform
   1. Dry weight of brain is 60% fat
   2. About 20% of the brain's fat is made from EPA's

B. Cannot be synthesized by the body
   1. LA and ALA must be obtained from dietary sources
   2. EPA, DHA, and arachidonic acid are formed in the 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. Precursors to neurochemicals involved in brain's blood flow, the immune system, and the neurotransmitter system
   1. Assist in uptake of NT's
   2. Play a role in decreasing inflammation

C. NEUROPLASTICITY and brain resiliency

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. EFA balance helps NT receptors function
   2. Supplementation may improve symptoms
      a. fish oil is 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 oils

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:
   a. Vitamin A, C, and E
   b. Plant pigments are also important antioxidants

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

- Plays 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 (PMHS).
- Supplementation may improve symptoms

3. Nutrients of Special Relevance to Mood and Mental Health

Further research is needed (and already underway) to clarify the effect of this vitamin on mental health and mood.

Use caution and speak with a doctor before taking mega doses of supplemental vitamin D.
3. Nutrients of Special Relevance to Mood and Mental Health

**B Vitamins**

Key Examples:

- Thiamine
- Folate (Folic Acid)
- Niacin
- B12
- B6

Implicated in cell division and innumerable of metabolic reactions, including within the nervous system

Required in NT synthesis

Major players in fetal brain and spinal cord development

Alcohol dependence often leads to deficiencies in folate, niacin, thiamine

**Probiotics**

Influence gut biota (gut flora), which are bacterial cultures in the small and large intestines that are involved with digestion, absorption, and other metabolic processes

1. Inoculation
2. Re-inoculation
3. ‘Crowding out’ Concept

Produce certain nutrients, including Vitamin K, some B vitamins (B12), and short-chain fatty-acids from FIBER

4. Promoting Recovery Through Diet

**Alcohol**

- One of the most common causes of nutrient deficiency in developed countries
- Provides energy, with more calories/gram than that of carbohydrate or protein
  - 7 kcal./gram vs. 4 kcal./gram
  - Only fat contains more energy truly 'empty' calories
- Provides some sense of fullness without eating

The Classic Anti-Nutrient

- Contain virtually no vitamins or minerals
- Extra amounts of certain vitamins are needed to break down and rid body of alcohol
- If alcohol intakes are >30% of total calories, deficiencies of vitamins A, vitamin C, and thiamine are common
4. Promoting Recovery Through Diet

**Alcohol**

- Abuse can result in:
  - Insomnia
  - Anorexia
  - Weight changes
  - GI cramping, nausea, vomiting
  - Decreased digestive enzymes
  - Ulcers
  - Muscle wasting
  - Severe malnutrition, anemia
  - Hypertension
  - Liver disease (cirrhosis)
  - Night blindness
  - Blood sugar imbalance, DM, gout
  - Eating disorders (bulimia, binge eating, etc.) are a common comorbidity
  - Causes oxidative stress to body
  - Damages delicate inner lining of intestines, impairing absorption of amino acids, vitamins, minerals
  - Wernicke-Korsakoff Syndrome
    - Marked by confusion, mental changes, abnormal eye movements, ataxia
    - Caused by severe thiamine deficiency by way of
      - Decreased absorption
      - Diuretic effect loss
      - Requirements of detoxification of body
      - Poor intake

**Opioids**

- Codeine, oxycodone, heroin, methadone, morphine, fentanyl
- Cause sedation
- Slow body movements
- Can result in reduced intakes and lead to nutrient deficiency
- Constipation is a likely side-effect
- Dental problems are possible
- Diarrhea, nausea, and vomiting are trademarks of withdrawal
- High-fiber meals may help foster normal gut function

**Stimulants**

- Cocaine, amphetamines, methamphetamine, nicotine, caffeine
- Suppress appetite
- Create oxidative stress
- Weight loss and low BMI are primary concerns
- Malnutrition and micronutrient deficiencies are possible
- Eating disorders may coexist
- Use can also result in:
  - Insomnia
  - Paranoid
  - Anxiety
  - Memory problems
  - Poor decision-making
- Electrolyte balance and hydration are focuses in recovery
- Adequate oral intakes will help to:
  - Restore a healthy BMI through weight gain
  - Repair damaged tissues
  - Reverse deficiencies

4. Promoting Recovery Through Diet
4. Promoting Recovery Through Diet

Special Considerations
Cross Addiction or Transference of Addiction
- substitution of a legal chemical/substance for an illegal one
- substitution of a non-intoxicating beverage for alcohol
- once an accepted principle in recovery
- common substitutes include:
  - caffeine
  - nicotine
  - sugar

Dopamine-releasing behaviors
- sex
- gambling
- performance ("workaholism")
- shopping, entertainment, media
- others?

Primary vs. Secondary Malnutrition
- primary = substance replaces other dietary nutrients
- secondary = substance causes improper nutrient metabolism, absorption, utilization, or excretion (even though diet may be adequate)

4. PROMOTING RECOVERY THROUGH DIET

Selected Goals of Medical Nutrition Therapy (MNT)
1.) Heal and nourish damaged tissues/organs of the body
   a. protein
   b. vitamin C and other antioxidants
   c. B vitamins
   d. water
2.) Correct nutrient deficiencies
   a. B vitamins
   b. vitamin A
   c. amino acids
   d. EFA's (omega-3/-6)
   e. electrolytes
3.) Stabilize Mood, Reduce Stress, and Mitigate Cravings
   a. blood sugar balance
   b. adequate hydration

4. PROMOTING RECOVERY THROUGH DIET

5. COMMON PITFALLS IN CONTEMPORARY NUTRITION MESSAGES
1. Reductionist view of nutrients
2. Compartmentalization of body systems
   - mind vs. body or mind & body as one
3. More = better view
   - versus moderation, variety, balance
   - in regards to foods and supplements
Thank You for Your Interest and Attention!

Questions?

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