Food Intake and Hormone Response

The Gut-Brain Connection

- Vagus nerve – The “Superhighway,” the longest cranial nerve.
- Runs from the brainstem to the colon.
- Involved in calming and arousal,
- Controls digestion, heart rate, breathing, and reflexes like coughing, sneezing, swallowing, and vomiting.
- Electrical activity between the gut and brain is ongoing and on the Circadian Rhythm.
- The digestive system is one long tube from the mouth to the anus with many sphincters and organs connected to it.
- The gut is an organ connected to the outside world and contains sensory cells at different locations of the entire digestive system to sense different things.
- Taste buds only know taste, while gut neurons also know the nutrient content of food.
- Nutrient sensing is performed by neuropod cells, which sense the three macronutrients, amino acids (AAs), sugar/carbohydrates (CHO), and fatty acids (FAs). They also sense food temperature and micronutrients (e.g., vitamins and minerals).

When We Eat, Hormones Are Released

- When you eat, your body releases several hormones to regulate appetite and digestion. Some stimulate food intake, while others signal satiety.
- Epithelial cells trigger hormone release that communicates more slowly. That was discovered in 2015, which shows we are still learning about the interaction between food types and hormone release as obesity rates continue to rise.
- In a study of animals craving sugar, even when mouth receptors were turned off, the gut sensed the sugar and created an unconscious craving for more.

- Consuming empty calories from CHO/sugar increases dopamine release, which is tied to insulin spikes and over-eating because the gut isn't satiated; only the mouth taste is creating the craving for more CHO/sugar.
- In a study regarding AAs:
  - Food with a small number of AAs caused cravings for more of it to get the body's requirement for AAs.
  - Food with no AAs caused the subjects to stop eating that meal because they were not sensing AAs.
  - If food had a high amount of fiber, gut neurons sensed it and craved the AAs in that food.
- Plant-based diets cause the body to crave fiber, sugar, and AAs.
- Eating good fat and protein sources signals the gut neurons to eventually sense satiety and decrease cravings, unlike out-of-control CHO consumption.

Specific Hormones Involved

- Ghrelin is released from the stomach to stimulate hunger and promote food consumption. Ghrelin acts on the hypothalamus, the brain region that controls appetite and energy balance. Ghrelin levels are higher before meals and decrease after eating.
- Leptin is produced by fat cells and signals the brain that the body has enough energy to suppress appetite. Leptin also acts on the hypothalamus; its levels are higher after eating and during fasting or when energy is restricted, when the body tries to burn fat.
- Cholecystokinin (CCK) is released from the small intestine in response to the presence of fat and protein. CCK promotes satiety and slows gastric emptying by signaling the brain to reduce eating and increase feelings of fullness.
- Glucagon-like peptide 1 (GLP-1) is released from the small intestine post-eating and promotes satiety and slower gastric emptying. By acting on the hypothalamus, it improves insulin sensitivity, which is why it is currently used as a weight loss option.
- Peptide YY (PYY) is released from the small intestine to reduce appetite

and slow down gastric emptying. PYY acts on the hypothalamus to promote satiety.

- Insulin is released from the pancreas in response to rising blood glucose levels. It plays a role in regulating blood sugar and can influence appetite.
- Pancreatic Polypeptide (PP) is released from the pancreas to suppress appetite and slow gastric emptying.
- Gastrin is released from the stomach in response to the presence of proteins. It stimulates the release of stomach acid to aid in digesting those proteins.

Current Day Weight Loss Options – FDA Approved

(NOTE: Wise and disciplined food consumption and proper exercise still work for those seeking to lose body fat and improve overall health metrics.)

Due to the out-of-control obesity epidemic, Big Pharma has jumped in neck-deep to help deter it (and profit big time financially). In the past, the popular solution was gastric bypass surgery (GBS). The purpose of GBS was to reduce the gut surface area to decrease calorie absorption. That is, less area for food = fewer calories entering the body. However, some who had GBS developed alcoholism. Recent research has shown that removing specific neuropod cells can alter food cravings, reducing the amount consumed and thus avoiding the invasive process of GBS.

Zepbound (tirzepatide):

- Binds to the GIP and GLP-1 receptors in the brain and gut, mimicking the effects of these hormones.
- GLP-1 signals the brain that the stomach is full, reducing appetite and food intake.
- Slows stomach emptying.
- GIP suppresses the release of glucagon, a hormone that raises blood sugar levels.
- GIP stimulates the breakdown of fat cells that may contribute to weight loss.
- Increases insulin secretion and improves insulin sensitivity, helping to regulate blood sugar levels.

- May stimulate fat burning by increasing the body's use of fat for energy.

Wegovy (semaglutide):

- A GLP-1 receptor agonist that helps regulate appetite and blood sugar levels.
- Slows down the emptying of the stomach, which helps prolong the feeling of fullness.
- By reducing appetite and delaying gastric emptying, it helps reduce calorie intake, leading to weight loss.

Mounjaro (tirzepatide):

- Like Zepbound, it binds to the GLP-1 and GIP receptors to increase the body's production of insulin, which helps lower blood sugar levels.
- GIP suppresses the release of glucagon, a hormone that raises blood sugar levels.
- GIP stimulates the breakdown of fat cells that may contribute to weight loss.
- GLP-1 slows down the digestion of food, which helps regulate appetite and reduce calorie intake.

Ozempic (semaglutide):

- Like Wegovy, it stimulates insulin secretion: GLP-1 tells the pancreas to release insulin, which lowers blood sugar levels.
- Slows gastric emptying, increases satiety, and reduces hunger and cravings, leading to reduced calorie intake.
- It helps those with type 2 diabetes by increasing insulin and regulating blood sugar levels.
- This can lead to significant weight loss in individuals with obesity.

Saxenda (liraglutide):

- As a glucagon-like peptide 1 (GLP-1) receptor agonist like Wegovy.
- Regulates hunger and calorie intake but is also approved for chronic weight management.

Contrave (naltrexone/bupropion):

- A combination medication containing naltrexone and bupropion.
- Naltrexone – an opioid antagonist that blocks the effects of the natural opioid endorphins that affect appetite reward pathways in the brain.
- Bupropion – An antidepressant that increases dopamine and norepinephrine to regulate appetite, energy use, and mood.
- Modulates neurochemical pathways in the brain to reduce appetite, increase satiety, and promote weight loss.

Qsymia (phentermine/topiramate):

- A combination medication containing the effects of phentermine and topiramate to reduce appetite and increase satiety.
- Phentermine acts as an appetite suppressant by stimulating the sympathetic nervous system to release hunger-reducing neurotransmitters.
- Topiramate affects neurotransmitters in the brain to reduce appetite and increase satiety.

Orlistat (Xenical, Alli):

- Promotes weight loss by decreasing the amount of dietary fat absorbed in the intestines.
- It blocks the function of lipase (the enzyme that breaks down dietary fat) so it can be used or stored for energy.

Setmelanotide (Imcivree):

- Approved for specific rare genetic disorders related to appetite and energy expenditure.
- It acts as a melanocortin-4 receptor (MC4R) agonist, a brain receptor that controls appetite and energy expenditure.