1-Physiology of feedings, appetite & hunger

Prepared
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Pleasure of eating
Hypothalamus and other glands

Hypothalamus
- Thyrotropin-releasing hormone
- Dopamine
- Growth hormone-releasing hormone
- Somatostatin
- Gonadotropin-releasing hormone
- Corticotropin-releasing hormone
- Oxytocin
- Vasopressin

Thyroid
- Triiodothyronine
- Thyroxine

Pineal gland
- Melatonin

Pituitary Gland
- Anterior pituitary
  - Growth hormone
  - Thyroid-stimulating hormone
  - Adrenocorticotropic hormone
  - Follicle-stimulating hormone
  - Luteinizing hormone
  - Prolactin

- Intermediate pituitary
  - Melanocyte-stimulating hormone

- Posterior pituitary
  - Oxytocin
  - Vasopressin
  - Oxytocin (stored)
  - Anti-diuretic hormone (stored)
• **appetite**: the integrated response to the sight, smell, thought, or taste of food that initiates or delays eating.

• **hunger**: the painful sensation caused by a lack of food that initiates food-seeking behavior

• **hypothalamus**: a brain center that controls activities such as maintenance of water balance, regulation of body temperature, and control of appetite.
• **satiation**: the feeling of satisfaction; and fullness that occurs during a meal and stop eating. Satiation determines how much food is consumed during a meal.

• **satiety**: the feeling of fullness and satisfaction that occurs after a meal and inhibits eating until the next meal. Satiety determines how much time passes between meals.
• **binge-eating disorder: an eating disorder** with criteria similar to those of bulimia nervosa, excluding purging or other compensatory behaviors.

• **Bulimia nervosa: an eating disorder** characterized by repeated episodes of binge eating usually followed by self induced vomiting, misuse of laxatives or diuretics, fasting, or excessive exercise.
Physiology of feeding

• Feeding - the placement of food in the mouth, and the treatment of food in the oral cavity
• mastication
• Swallowing –
• The swallowing process is commonly divided into oral, pharyngeal, and esophageal stages according to the location of the bolus.
• Deglutition - process of swallowing
Physiology of appetite and hunger

Regulation of food intake

• Ingestion of food is determined by the intrinsic desire of the person for food, this is called hunger

• hunger is the physiological response to a need for food caused by nerve signals and chemical messengers originating and acting in the brain, primarily in the hypothalamus.

• Hormones of hypothalamus promotes thoughts of eating

• The type of food the person preferred is determined by appetite
• when there are no food for many hours, the stomach undergo intense rhythmic contraction called **hunger contractions**

• These contraction cause a tight feeling in the stomach and cause pain known as **hunger pangs**

• Hungry person also become more tense and restless and often has a strange feeling in his entire body
• After a meal Satiety is developed; this means the feeling of fullness and satisfaction that occurs after a meal and inhibits eating until the next meal. Satiety determines how much time passes between meals.

• the feeling of satiety continues to suppress hunger and allows a person to not eat again for a while.
During the course of a meal, as food enters the GI tract and hunger diminishes, satiation develops “stop eating,”.

As receptors in the stomach stretch and hormones such as cholecystokinin become active, the person begins to feel full. The response: satiation occurs and the person stops eating.
Coordination of systems to feeding
Factors influences hunger

• 1-Physiological influences of hunger
  • Empty stomach
  • Gastric contractions
  • Absence of nutrients in small intestine GI
  • Hormones such as Ghrelin that produced by fundus of the human stomach and cells of the pancreas and Leptin release from adipose tissue
• **Endorphins** (the brain’s pleasure chemicals)
• Endorphins are neurotransmitters produced by pituitary gland and hypothalamus
• enhancing the desire for food by the smell, sight, or taste of foods,
• **Dopamine** is classified as a catecholamine (a class of molecules that serve as neurotransmitters and hormones).
• 2-Sensory influences
• Seek food and start meal
• Thought, sight, smell, sound, taste of food
Endorphins
• 3-Cognitive influences
• Keep eating
  • Presence of others, social stimulation
  • Perception of hunger, awareness of fullness
  • Favorite foods, foods with special meanings
  • Time of day
  • Abundance of available food
• **4-Postingestive influences** (after food enters the digestive tract)

• **Satiation: End meal**

• Food in stomach activates stretch receptors

• Nutrients in small intestine draw out hormones (for example, fat draw out cholecystokinin, which slows gastric emptying)

• cholecystokinin, receptor regulates satiety and the release of beta-endorphin and dopamine.

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• **5-Postabsorptive influences** (after nutrients enter the blood)

• **Satiety: Several hours later**

• Nutrients in the blood signal the brain (via nerves and hormones) about their availability, use, and storage

• As nutrients decrease, satiety diminishes

• Hunger develops
Neural Centers for regulation of food intake hypothalamus.

• Most hormones are secreted from the glands that produce them under the influence of stimulating hormones from the hypothalamus.

• The hypothalamus is a part of the brain involved in the control of involuntary activity in the body; contains many centers of neural control such as temperature, hunger, appetite and thirst.

• These hormones in turn are activated by releasing hormones from the pituitary gland.
Hypothalamus The part of the brain that lies below the thalamus. contains many centers of neural control such as temperature, hunger, appetite and thirst.
Lateral hypothalamus & Ventromedial nuclei of the hypothalamus

• Hunger and satiety centers; hypothalamus gland responsible of the hunger and satiety

• Lateral hypothalamus stimulation cases a person to eat greedily or hunggrily (hunger or feeding center neurotransmitters Endorphins)

• Ventromedial nuclei of the hypothalamus causes the sensation of food rejection or complete satiety (satiety center neurotransmitters)
• Destructive lesions or trauma of the Lateral hypothalamus causes complete lack of desire for food

• While destructive lesions of the Ventromedial nuclei of the hypothalamus cause voracious and the person continued eating until it become extremely obese (overactive)
Diencephalon

- Right thalamus
- Left thalamus
- Cerebellum
- Hypothalamus
Other Neural Center that enter into feeding

• Another area of the hypothalamus Mammillary bodies activate feeding reflexes such as licking the lips and swallowing

• another area higher centers than hypothalamus control feeding mainly appetite include amygdala and cortical areas of the limbic system which is coupled with the hypothalamus
The brain as viewed from the underside and front. The thalamus and Corpus Striatum (Putamen, caudate and amygdala) have been splayed out to show detail.

**Corpus Striatum**

- Caudate nucleus
- Lenticular nucleus (globus pallidus and putamen)
- Amygdala
• Destructive lesions in the amygdala increase feeding while other inhibit feeding (choice of food loses the mechanism of appetite control and quality of food)
• The cortical regions of the limbic system have areas when stimulated can increase or decrease feeding activities
• It is believed that theses centers with amygdala and hypothalamus responsible of the quality of food that is eaten
Limbic system
Factors that regulate food intake

- Regulation of food intake can be divided into;
- 1-nutritional regulation (metabolic regulation); concerned with the maintenance of normal quantities of nutrient stores in the body
- Factors that control the degree of activity of feeding center of the hypothalamus are;
• A) Decrease in blood glucose concentration is associated with the development of hunger (the glucostatic regulation theory of hunger and feeding regulation)
• B) the effect of blood amino acid concentration on feeding; increase concentration of amino acid in the blood reduces feeding activity
• C) effect of fat metabolism on feeding (long term feeding); as the quantity of adipose tissue increases the rate of feeding decrease this is caused by a negative feedback regulation
• D) body temperature and food intake interrelationship; cold person tends to overeat
• When exposed to heat tends to under eat
• This relationship is due to interaction within the hypothalamus between the temperature regulation system (hypothalamic thermostat) and the food regulating system (Lateral hypothalamus & Ventromedial nuclei of the hypothalamus)
• The temp of the body is regulated by nervous feedback mechanisms these mechanisms operate through temperature regulating centers in the hypothalamus
• 2-alimentary regulation, non-metabolic regulation; Habit, Gastrointestinal filling
Hormonal control of feeding, appetite and hunger

- Hormones that play an important role in controlling feeding pattern;
- **leptin** (identified in 1994), Leptin release from adipose tissue is enhanced by insulin
- Obese persons are found with high circulating leptin levels but without response to leptin in the arcuate nucleus (aggregation of neurons in the hypothalamus)
- Neurons are nerve cells that receive and send electrical signals over long distances within the body
• Acts on hypothalamus to decrease food intake and increase energy consumption

• Abnormalities in leptin signaling appear to be correlated to overeating and obesity
• ghrelin (identified in 1999), called "hunger hormone," is produced in the stomach and brain, induces food intake, and operates through a brain region that controls cravings for food and other energy sources

• ghrelin is peptide hormone secreted by gastric mucosa, on an empty stomach and during fasting this hormones increase, and level fall rapidly after meal

• work together with leptin to balance the states of hunger and satiety
• **Insulin** release from pancreatic islets cells follows intake of both carbohydrates and proteins.

• Insulin increase appetite by inhibiting stimulatory neurons and by activating releasing neurons.

• Resistance to insulin is very often associated with obesity and the loss of insulin's regulation of metabolism as seen in diabetes type 2.
• Insulin increase appetite by inhibiting stimulatory neurons and by activating releasing neurons.

• Resistance to insulin is very often associated with obesity and the loss of insulin's regulation of metabolism as seen in diabetes type 2.
• **orexin**, Also called Hypocretins – neurotransmitter hormones that increase food intake,

• Synthesized in neurons located in the lateral Hypothalamus

• **orexin** are inhibited by leptin and activated by Ghrelin and Hypoglycemia
The healthy eating cycle

The Healthy Eating Cycle

HUNGER

SATISFACTION

ANTICIPATION

FULLNESS

EAT

Pleasure
Eating disorder

• Both men and women are susceptible to eating disorders, although a greater percent of eating disorders are found in women.
• The three most common eating disorders found are:
  • 1- Anorexia Nervosa,
  • 2- Bulimia,
  • 3- Compulsive Exercise
Warning Signs of an Eating Disorder

- Preoccupation (worry) with food and weight
- Repeatedly expressed concerns about being fat
- Increasing criticism of one's body
- Frequent eating alone
- Use of laxatives
- Trips to the bathroom during or following meals
- Continuous drinking of diet soda or water
- Compulsive, excessive exercise
- Complaining of always being cold
Anorexia nervosa

• **Anorexia nervosa**: an eating disorder characterized by a refusal to maintain a minimally normal body weight and a distortion in perception of body shape and weight (BMI ≤ 17.5)

Excessive concern with weight or weight gain
Health Complications from Anorexia

• Anorexia poses life-threatening complications including:
  • malnutrition
  • Abnormal Heart Rhythms
  • low blood pressure
  • Dehydration
  • electrolyte imbalance
  • amenorrhea (interruption of the menstrual cycle)
  • osteoporosis (decreased bone mass)
  • sleep disorder
Signs and Symptoms of Anorexia

- Excessive weight loss
- Always thinking about food, calories, and body weight
- Wearing layered clothing
- Mood swings or depression
- Inappropriate use of laxatives, or diuretics in order to lose weight
- Avoiding activities that involve food
Diet Strategies for Anorexia nervosa

• **Appropriate diet** is vital to recovery and must be according to each individual’s needs.

• Initial food intake may be only 1200 kcalories per day.

• A variety of foods and foods with a higher energy density help to ensure greater success.

• As eating becomes more comfortable, a person with anorexia should gradually increase energy intake.
Bulimia

• Bulimia is one such eating disorder that describes a cycle of binging and purging.

• Bulimia can begin when restrictive diets fail, or the feeling of hunger associated with reduced calorie intake leads to reduce eating.

• Like the person with anorexia nervosa, the person with bulimia nervosa spends much time thinking about body weight and food.
• Bulimia are multi-factorial, with psycho-developmental, socio-cultural, and genetic contribution factors
Bulimia is of Two types:

• **1-Purging type:** The person regularly engages in self-induced vomiting or the misuse of laxatives, diuretics.

• **2-Nonpurging type:** The person uses other compensatory behaviors, such as fasting or excessive exercise, but does not regularly engage in self-induced vomiting or the misuse of laxatives, diuretics,
The Binge-Purge Cycle has no beginning or end, Bulimia is an addictive cycle on both physical and emotional levels., this sequence involves a self-sustaining series of events and edictable response.
Signs and Symptoms of Bulimia

• Excessive weight loss

• Visiting the bathroom after meals

• Depression

• Excessive dieting, followed by binge eating

• Always criticizing one's body
Diet Strategies for Combating Bulimia Nervosa

• **Nutrition Principles**
  • Eat a well-balanced diet and regularly timed meals consisting of a variety of foods.
  • Include raw vegetables, salad, or raw fruit at meals to prolong eating times.
  • Choose whole-grain, high-fiber breads, pasta, rice, and cereals to increase bulk.
  • Consume adequate fluid, particularly water
Compulsive Exerciser

• Some athletes suffer from a slight form of eating disorder that results in excessive and addictive exercise in an attempt to control or lose weight.

• Addictive exercisers may use extreme training as one way to expend calories and maintain or lose body weight in the attempt to improve performance or achieve a desired body shape or weight.
Warning Signs of a Compulsive Exerciser

• suffer symptoms of overtraining syndrome.
• Force to exercise even if you don't feel well.
• almost never exercise for fun
• Every time you exercise, you go as fast or hard as you can.
• experience severe stress and anxiety if he or she miss a workout.
• You miss family obligations because you have to exercise.
• Compulsive exercise is as dangerous as food restriction, binging and purging and the use of diet pills and laxatives.

• Compulsive exercise can quickly lead to more serious types of eating disorders including anorexia and bulimia as well as a number of serious physical dangers including kidney failure, heart attack and death.
Unspecified Eating Disorders, Binge-Eating Disorder

• Binge-Eating Disorder
• People with binge eating disorder consume less during a binge, rarely purge, and exert less restraint (self control) during times of dieting
• Such an eating disorder does not meet the criteria for either anorexia nervosa or bulimia nervosa
• such compulsive overeating is a problem and occurs in people of normal weight as well as those who are severely overweight.
• Obesity alone is not an eating disorder
• There are also differences between obese binge eaters and obese people who do not binge. Those with the binge-eating disorder report higher rates of disgust about body size, depression, and anxiety.
• Obese binge eaters tend to consume more kcalfories and more dessert
• Sareen Gropper, Jack Smith and James Groff, *Advanced Nutrition and Human Metabolism*, fifth ed. WADSWORTH

• Melvin H Williams 2010; Nutrition for Health, Fitness and Sport. 9th ed, McGraw Hill

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