

Physiology of appetite; control of feed intake

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. This 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. It determines how much time passes between meals.

Physiology of feeding

Feeding - the placement of food in the mouth and the treatment of food in the oral cavity

Swallowing – The swallowing process is commonly divided into oral, pharyngeal, and esophageal stages according to the location of the bolus.

Deglutition - process of swallowing

Regulation of food intake

Ingestion of food is determined by the intrinsic desire of the person for food, this is called hunger. It 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 promote thoughts of eating. The type of food the person preferred is determined by appetite. When there is no food for many hours, the stomach undergoes intense rhythmic contraction called hunger contractions. These contractions cause a tight feeling in the stomach and cause pain known as hunger pangs. Satiety determines how much time passes between meals and 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.

Factors influences hunger

1 Physiological influences of hunger

2 Empty stomach

3 Gastric contractions

4 Absence of nutrients in small intestine

5 GI Hormones such as Ghrelin, produced by fundus and cells of the pancreas and Leptin release from adipose tissue.

Endorphins (the brain’s pleasure chemicals) are neurotransmitters produced by pituitary gland and hypothalamus enhances the desire for food by the smell, sight or taste of food. Dopamine is classified as a catecholamine (a class of molecules that serve as neurotransmitters and hormones).

Cognitive influences consists

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

Postingestive influences (after food enters the digestive tract)

Satiation activates stretch receptors and nutrients in small intestine draw out hormones (fat draw out cholecystokinin which slows gastric emptying). Cholecystokinin receptor regulates satiety and the release of beta-endorphin and dopamine.

Post-absorptive 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 and 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. It 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.

Lateral hypothalamus & Ventromedial nuclei of the hypothalamus

Hypothalamus gland is responsible for the hunger and satiety. Lateral hypothalamus stimulation causes a person to eat greedy or hungry (hunger or feeding center neurotransmitters Endorphins). Ventromedial nuclei of the hypothalamus causes the sensation of food rejection or complete satiety. Destructive lesions or trauma of the lateral hypothalamus causes complete lack of desire for food, while destructive lesions of the Ventr-medial nuclei of the hypothalamus cause; voracious and the person continued eating until it become extremely obese (overactive)

Other Neural Center that enter into feeding

Mammillary bodies activate feeding reflexes such as licking the lips and swallowing. Higher centers than hypothalamus control feeding mainly appetite include amygdala and cortical areas of the limbic system which is coupled with the hypothalamus. Destructive lesions in the amygdala increase feeding while other inhibit feeding. The cortical regions of the limbic system have areas when stimulated can increase or decrease feeding activities.

Limbic system

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.

2 Factors that control the degree of activity of feeding center of the hypothalamus are

A) Decrease in blood glucose concentration, associated with the development of hunger (the glucostatic regulation theory of hunger and feeding regulation)

B) 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 and when exposed to heat tends to under eat. This relationship is due to interaction within the hypothalamus between the temperature regulation system and the food regulating system

The temp of the body is regulated by nervous feedback mechanisms these mechanisms operate through temperature regulating centers in the hypothalamus via alimentary regulation, non-metabolic regulation, habit and Gastrointestinal filling.

Hormonal control of feeding, appetite and hunger

Leptin plays an important role in controlling feeding pattern, it releases from adipose tissue and 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. This acts on hypothalamus to decrease food intake and increase energy consumption. Abnormalities in leptin signaling appear to be correlated with overeating and obesity.

Ghrelin also 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. This work together with leptin to balance the state 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 is associated with 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 are neurotransmitter hormones that increase food intake. These are synthesized in neurons located in the lateral Hypothalamus. Orexin are inhibited by leptin and activated by Ghrelin and Hypoglycemia.