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ANATOMICAL AND PHYSIOLOGICAL CHARACTERISTICS OF THE STOMACH

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Annotatsiya

Oshqozon ovqat hazm qilish tizimining asosiy organlaridan biri bo'lib, ovqatni vaqtincha saqlash, mexanik va kimyoviy jihatdan parchalash, ximüs hosil qilish hamda oziq moddalarni keyingi hazm qilishga tayyorlash vazifalarini bajaradi. Ushbu maqolada oshqozonning anatomik tuzilishi (kardiya, fundus, korpus, antrum va pilorus bo'limlari, devorining qatlamlari, glandular epiteliy va maxsus hujayralar), fiziologik xususiyatlari (me'da shirasi sekretsiyasi, motillik, gormonal va nerv regulyatsiyasi) hamda ovqat hazm qilish jarayonidagi o'rni to'liq yoritilgan. Maqola tibbiyot talabalari, mutaxassislar va ovqat hazm tizimi fiziologiyasiga qiziqqan barcha uchun foydali manba hisoblanadi.

Kalit so'zlar:

oshqozon, me'da, anatomiya, fiziologiya, ovqat hazm qilish, ximüs, me'da shirasi, parietal hujayralar, pepsinogen, sirkali kislota, motillik, gastrin, sekretsiya.

Abstract:

Желудок является одним из основных органов пищеварительной системы, выполняющим функции временного хранения пищи, её механической и химической обработки, образования химуса и подготовки питательных веществ к дальнейшему перевариванию. В данной статье подробно освещено анатомическое строение желудка (отделы: кардиальный, фундальный, тело, антральный и пилорический; слои стенки, железистый эпителий и специализированные клетки), физиологические особенности (секреция желудочного сока, моторика, гормональная и нервная регуляция) и его роль в процессе пищеварения. Статья служит полезным источником для студентов-медиков, специалистов и всех интересующихся физиологией пищеварительной системы.

Keywords:

желудок, анатомия, физиология, пищеварение, химус, желудочный сок, париетальные клетки, пепсиноген, соляная кислота, моторика, гастрин, секреция.

Abstract:

The stomach is one of the main organs of the digestive system, responsible for temporary storage of food, its mechanical and chemical processing, chyme formation, and preparation of nutrients for further digestion. This article comprehensively covers the anatomical structure of the stomach (regions: cardia, fundus, body, antrum, and pylorus; wall layers, glandular epithelium, and specialized cells), its physiological features (gastric juice secretion, motility, hormonal and neural regulation), and its role in the digestive process. The article serves as a

useful resource for medical students, professionals, and anyone interested in the physiology of the digestive system.

Keywords:

stomach, gastric anatomy, gastric physiology, digestion, chyme, gastric juice, parietal cells, pepsinogen, hydrochloric acid, gastric motility, gastrin, secretion.

Introduction

The digestive system in the human body is a complex and interconnected set of organs whose main function is to receive food from the outside, break it down, absorb nutrients, and excrete waste. One of the central members of this system is undoubtedly the stomach (stomach). The stomach plays an important role in the digestion process, since it not only temporarily preserves food, but also mechanically and chemically reproduces it and prepares it for the next stages. Since ancient times, medical scientists have called the stomach the "main laboratory of digestion," and this definition has not lost its relevance today. The stomach is anatomically described as a J-shaped muscular organ located in the upper part of the abdominal cavity, mainly in the left hypochondrium (epigastrium and left hypochondrium). Its dimensions vary depending on a person's age, gender, eating habits, and overall body condition. While the stomach is empty, it is about 0.5 liters in size, but when full, it can hold 2-4 liters of food and liquid. This stretch feature is caused by special folds (rugae) on the stomach wall. When food enters, the folds are smoothed out, the volume of the organ increases sharply, and after digestion, it returns to its old state again.

Anatomically, the stomach is divided into several sections. From top to bottom: cardiac (cardia) part, fundus (lower part or vault), corpus (body), antrum (pylorus), and pyloric (pylorus) part. Each department has its own structure and function. For example, the cardiac part connects to the esophagus, ensuring that food passes into the stomach, while the pyloric part controls the passage of food from the stomach into the small intestine. The stomach wall is made up of four main layers: the mucous membrane (mucosa), submucosa, muscular layer (muscularis), and serous layer. The muscular layer consists of three types of fibers (longitudinal, circular, and oblique) that are specific to the stomach, allowing for vigorous mixing and grinding of food.

Physiologically, the stomach is a very complex and multifunctional organ. One of its most important functions is secretory function. Special glands in the gastric mucosa (located in the fundus and corpus) produce gastric juice. Gastric juice contains acetic acid (HCl), pepsinogen, lipase, mucus, and other biologically active substances. Acetic acid disinfects food, while pepsinogen is converted into the enzyme pepsin, which breaks down proteins. In addition, the stomach regulates its activity and the entire digestive system through the production of hormones (gastrin, somatostatin, etc.). Another important physiological feature is motor (motion) function. The stomach muscles continuously mix, grind, and gradually move food through the pyloric sphincter into the small intestine in the form of chyme through peristaltic and tonic contractions. This process is controlled by neurohumoral mechanisms (vagus nerve, enteric nervous system, and hormones). The stomach plays a major role not only in digestion, but also in the overall homeostasis of the body. It has the ability to absorb water and certain substances (such as alcohol, aspirin, and some vitamins), and it also participates in protecting the immune system. However, the modern lifestyle (stress, poor diet, smoking, alcohol, and excessive use of NSAIDs) is leading to an increase in stomach diseases (gastritis, ulcers, tumors). Therefore, a thorough study of the anatomical and physiological characteristics of the stomach is extremely important not only for theoretical, but also for practical medicine. This article will detail the structure and mechanisms of the stomach based on scientific literature and modern research. The goal is to

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give readers a complete and understandable idea of the stomach, as well as to reveal the subtle processes in its activity. Because only a healthy stomach can ensure that the whole organism is healthy.

Stomach cells and acids

The physiological activity of the stomach is mainly carried out by special cells in the structure of its mucous membrane (mucosa). These cells are different, each with a specific function. The gastric glands are located mainly in the fundus and corpus, and are composed of three types of principal cells: parietal (oxyntic), chief (zymogen or principal), and mucous cells. In addition, enteroendocrine cells (G-cells, D-cells, etc.) also play an important role. Parietal (oxyntic) cells are one of the most important cells in the stomach. They are mainly located at the top of the fundus and Corps. These cells produce acetic acid (HCl) and intrinsic factor (intrinsic factor). The process of producing acetic acid is very complex and is carried out using the H+/K+-ATPase enzyme (proton pump). Parietal cells produce carbonic acid from carbon dioxide and water obtained from blood vessels. Then, through the proton pump, hydrogen ions (H^+) are released from the cell into the stomach cavity through channels, while chloride ions (Cl^-) passively follow. As a result, the pH level in the stomach can decrease to 1.5–2.0. This very high acidity is necessary to disinfect food, activate pepsinogen and denature proteins. The activity of parietal cells is influenced by many factors. The vagus nerve (parasympathetic nervous system), the hormone gastrin, and histamine (via H2 receptors) stimulate these cells. In contrast, prostaglandins and somatostatin weaken their activity. The internal factor (intrinsic factor), on the other hand, ensures that vitamin B12 is absorbed in the intestine. Therefore, impaired function of parietal cells (e.g., in autoimmune gastritis) leads to B12 deficiency and pernicious anemia. Chief (main or zymogen) cells produce a precursor form of the enzyme pepsinogen. When pepsinogen is released into the stomach, it is converted into the enzyme pepsin under the influence of an acidic environment. Pepsin breaks down proteins, breaking them down into smaller peptides. Chief cells are also found in large numbers in the fundus and corpus. Their activity is also controlled by the nervous and hormonal systems.Mucosal cells (mucus-producing cells) are important for protecting the stomach wall from its pungent acid and pepsin. They secrete viscous mucus (mucus) and bicarbonate ions. The mucus forms a thick layer that protects the stomach wall from mechanical damage and chemical erosion. Bicarbonates, on the other hand, keep the pH under the mucus at a neutral level. This is called the "mucosal-bicarbonate barrier." If this protective mechanism is impaired (for example, NSAID drugs, exposure to Helicobacter pylori infection or severe stress), it leads to ulcers. In addition, enteroendocrine cells are also present in the stomach. Of these, G-cells (mainly in the antrum) produce the hormone gastrin. Gastrin stimulates parietal cells to increase acid secretion. D-cells produce somatostatin, limiting the formation of excess acid. ECL-cells (enterochromaffin-like), on the other hand, release histamine.

Stomach acids and their role.

The main acid in the stomach is chlorovodorod (acetic) acid (HCl). Its concentration can reach up to 0.16 m in gastric juice. Acetic acid has several important functions:

- Disinfects food — kills many bacteria, viruses, and fungi.
- Converts pepsinogen to the enzyme pepsin.
- Denatures proteins to facilitate enzymatic action.
- Improves the absorption of iron, calcium and other minerals.
- Facilitates mechanical breakdown of food.

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Gastric juice also contains other enzymes: lipase (partially breaks down fats) and lysozyme (has antibacterial properties). But the breakdown of carbohydrates and nucleic acids in the stomach practically does not occur, since the corresponding enzymes are not enough here. The activity of gastric cells and acids is subject to a complex regulatory system. The secretory phases are divided into three: cephalic (when food is seen and smelled), gastric (when food is in the stomach), and intestinal (when food passes into the intestine). Different neural and hormonal signals are involved at each stage. Modern research shows that stomach cells play an important role not only in digestion, but also in immune response, hormonal regulation, and even communication with the central nervous system. For example, the Helicobacter pylori bacterium affects parietal cells, causing chronic gastritis and ulcers.

Digestive function of the stomach

The stomach performs one of the most important stages of the digestive system. It not only temporarily stores food, but also prepares it for further digestion by subjecting it to thorough mechanical and chemical processing. The digestive function of the stomach involves several important processes: mechanical breakdown, chemical digestion, formation of chyme, and gradual transfer of food to the small intestine.

1. Mechanical digestion function

Once food enters the stomach, its muscular wall continuously mixes and grinds the food through powerful contractions (peristalsis). The three-directional muscle fibers in the stomach wall (longitudinal, circular, and diagonal) make this process very effective. As a result, solid food particles are broken down into small particles. This mechanical action greatly increases the surface area of the food, facilitating the action of enzymes. When the peristaltic waves of an empty stomach are weak, they increase after the arrival of food. Depending on the consistency of the dish, mechanical processing can take up to 1-4 hours. Liquid foods pass through the stomach faster, while solid and fatty foods last longer.

2. Chemical digestion function

The main weapon of the stomach in chemical digestion is gastric juice. On average, a person produces 2-2.5 liters of gastric juice per day. This juice consists of the following substances:

Hydrochloric acid (HCl) — reduces the pH of the stomach to 1.5-2.0. It disinfects food, denatures proteins, and converts pepsinogen to the active enzyme pepsin.

* Pepsin is a major proteolytic enzyme. It cleaves proteins from large molecules to smaller peptides. Pepsin works best in an acidic environment.

- Lipase — partially breaks down fats (especially milk fats).
- Mucus — protects the stomach wall from the effects of acid and pepsin.

* Bicarbonates-provide local neutralization.

* Internal factor (Intrinsic factor) — necessary for the absorption of vitamin B12.

The process of chemical digestion depends on the composition of the food. Protein-rich foods (meat, fish, eggs) are most thoroughly processed in the stomach. Carbohydrates, on the other hand, are mainly broken down in the mouth and are almost completely stopped in the stomach (because amylase is inactivated in an acidic environment). Fats begin to break down more slowly in the stomach.

3. Formation and evacuation of mucus

As a result of mechanical and chemical processing, food is converted into a semi-liquid, acidic mass - chyme. The formation of chyme is one of the main results of digestion. The chyme

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is slowly (about 3-5 ml each time) transferred through the pyloric sphincter into the duodenum. This process is very strictly regulated, since the neutral environment of the duodenum is sensitive to the acidity of the hummus.

The rate of food evacuation depends on the composition of the food:

Liquid foods — within 1-2 hours

Mixed foods — within 2-4 hours

Fatty and solid foods — up to 4-6 hours

4. Other functions

In addition to digesting food, the stomach also performs the following functions:

Reservoir function is the gradual distribution of food, rather than passing it into the intestine at once. Protective function-destroys most harmful microorganisms due to high acidity. Endocrine function — produces gastrin, somatostatin, and other hormones. Absorption function — absorbs water, alcohol, some drugs, and a small portion of minerals. The digestive function of the stomach is controlled by complex neurohumoral mechanisms. The vagus nerve enhances secretion and motility. The sight, smell, and taste of food trigger the cephalic phase. When food is in the stomach, the gastric stage is activated, and when it passes into the intestine, the intestinal stage is activated. In modern life, malnutrition, stress, Helicobacter pylori infection and certain medications can disrupt the digestive function of the stomach. As a result, gastritis, stomach ulcers, dyspepsia, and other diseases occur. Therefore, it is very important to follow a diet, reduce stress, and seek medical advice when necessary to maintain normal stomach function.

Stomach enzymes

The stomach actively participates in the digestive process, not only by mechanical mixing and acid production, but also by using special biological catalysts - enzymes. Enzymes are proteins that accelerate chemical reactions. The enzymes produced in the stomach are mainly specialized in breaking down proteins (proteolytic enzymes) and partially breaking down fats (lipolytic enzymes). Their activity is most effective in the highly acidic environment of the stomach (pH 1.5–3.5). About 2-2.5 liters of gastric juice are produced in the stomach per day,and enzymes play an important role in the composition of this juice.The formation and activation of gastric enzymes is carried out by special cells. Chief (zymogenic or basic) cells synthesize previous forms of enzymes (proferments). Then they go out into the stomach cavity and, under the influence of an acidic environment, go into an active state. This mechanism is essential to protect the stomach from self-digestion (autolysis).

1. Pepsin is the main proteolytic enzyme of the stomach.

Pepsin is the most important and most studied of the stomach enzymes. It is synthesized by chief cells in the form of pepsinogen. Pepsinogen is an inactive proenzyme with a molecular weight of approximately 42,000 Da. Once in the stomach, pepsinogen is converted into active pepsin by hydrochloric acid (HCl), releasing 44 amino acids. This process is autocatalytic, meaning that the pepsin formed activates other pepsinogen molecules. Pepsin hydrolyzes proteins (proteins). It particularly cleaves peptide bonds between phenylalanine, tyrosine, leucine, and other hydrophobic amino acids. As a result, large protein molecules are broken down into smaller polypeptides and oligopeptides. This breakdown is then further deepened in the small intestine by the action of trypsin, chymotrypsin and carboxypeptidases.

Optimal pepsin conditions:

pH: 1.5–2.5 (highest activity)

Temperature: 37–40°C

Its activity is maintained at high acidity, with rapid inactivation in neutral or alkaline environments. Pepsin plays an important role in the digestion of meat, fish, eggs, dairy products and vegetable proteins. Although the contribution of pepsin to total digestion in adults is around 10–20%, it is essential for initial breakdown.

2. Gastricin (Pepsin C or parapepsin)

Gastricin is an isozyme of pepsin, produced in smaller amounts in the stomach. It is also synthesized by chief cells and activated in an acidic environment. Gastrixin breaks down some proteins better, in particular milk protein casein. In newborns and the lactation period, the amount of gastrixin is relatively high.

3. Chymosin (Rennin or chymosin)

Chemosine is mainly active in the stomach of babies. It breaks down milk protein casein in the presence of calcium ions, bringing it to a solid mass (cheese-like coagulate) state. This ensures that the milk stays in the stomach for a longer time and is better digested. In adults, the production of chymosin is sharply reduced because milk is not a staple food.

4. Gastric lipase (gastric lipase)

The enzyme lipase is produced in smaller amounts in the stomach, but it is important, especially in infants. It hydrolyzes short- and medium-chain triglycerides (milk fats, coconut oil) and breaks them down into fatty acids and glycerol. In adults, gastric lipase accounts for only 10–30% of total fat digestion, as the main lipase is secreted from the pancreas (in the small intestine). Some medications (including NSAIDs) reduce mucus production and increase the risk of enzymes damaging the stomach wall. In medicine, gastric juice analysis, pH-metry, and special enzyme tests are used to assess gastric enzymes. To restore enzyme activity, a diet, proton pump inhibitors, prokinetics, and, if necessary, enzyme preparations are prescribed. In conclusion, gastric enzymes, especially the pepsin group, provide an initial and very important stage of digestion. Their proper synthesis, activation and regulation determine the nutritional effectiveness of the whole organism. The rhythm of modern life, stress, and poor nutrition can disrupt this delicate balance, making stomach enzyme protection essential for everyone's health.

Motor (movement) function of the stomach

The motor function of the stomach is one of its most important physiological characteristics, providing mechanical processing, mixing, grinding, and gradual transfer of food to the small intestine. This function is achieved through regular contractions of the muscular layer of the stomach wall. In the absence of motor activity, food is simply retained and chemical digestion is ineffective. Therefore, motor and secretory functions are closely related. The muscle structure of the stomach wall the muscle layer of the stomach wall (tunica muscularis), unlike other digestive organs, consists of muscle fibers in three directions: longitudinal (longitudinal) fibers — mainly located in the outer layer. Circular (circular) fibers — form the middle layer and are the strongest layer. Diagonal (oblique) fibers — are in the inner layer and are characteristic of the stomach. They play an important role in mixing food. These three sets of muscles work together to powerfully mix food in different directions. In the pyloric part, the circular muscles thicken to form the pyloric sphincter.

Main types of Motor function

1. Tonic contractions(tone

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The stomach is constantly in a certain state of tone. This tone increases when food arrives and adjusts the size of the organ (receptive relaxation). As food enters the stomach, the fundus and corpus relax, allowing large amounts of food to be accommodated without pressure. This mechanism is controlled by the vagus nerve and provides the "food intake" reflex. 2. Peristaltic waves Strong peristaltic contractions begin 5–10 minutes after food enters the stomach. These waves propagate from the cardia to the pylorus. Each peristaltic wave lasts approximately 15–20 seconds and has a speed of 1–3 cm/second. Peristaltic waves are divided into two types: mixing (mixing) peristalsis — thoroughly mixing food with mucus and gastric juice. Evacuatory (propulsive) peristalsis — pushes the chyme towards the pylorus. 3. Systolic contractions Strong systolic contractions occur in the pyloric part. These contractions temporarily open the pyloric sphincter, allowing a small portion of the chyme (about 3–5 ml) to pass into the duodenum. The remainder is pushed back (retropulsion) and mixed again. This process helps to thoroughly grind the food. Stages of motor activity The motor function of the stomach varies depending on the type and amount of food:

- Liquid foods → are evacuated quickly (30 minutes – 2 hours).

* Mixed foods → 2-4 hours.

* Fatty and hard foods → take 4-6 hours or more.

• Fatty foods slow down gastric emptying by stimulating the hormone cholecystokinin (CCK) released from the intestine (enterogastric reflex).

Clinical significance of the stomach in the body

The stomach is not only a part of the digestive system, but also a very important strategic organ for the normal functioning of the entire organism. Disruption of its anatomical and physiological properties can lead to many diseases, nutritional disorders, metabolic, and even neurological problems. In modern medicine, stomach diseases are one of the most common pathologies, the prevention and treatment of which is an urgent issue for every doctor and every person.

1. Role in digestion and nutrition

The stomach acts as the center of initial deep processing of food. With its help, proteins are hydrolyzed into peptides under the influence of pepsin, and fats are partially hydrolyzed under the influence of lipase. Acetic acid disinfects food and prepares it for the next stages. If the motor or secretory function of the stomach is impaired, the digestive process in the small intestine will also be incomplete. The result is nutrient deficiencies (malabsorption), weight loss, anemia, and general weakness. For example, atrophic gastritis lacks an internal factor (intrinsic factor) when parietal cells die. This interferes with the absorption of vitamin B12, leading to pernicious anemia (a severe blood deficiency caused by a lack of B12). The patient experiences inflammation of the tongue, neurological disorders (paresthesia, gait disorders) and even mental changes.

2. Infection protection function

The high acidity of the stomach (pH 1.5–2.0) kills many pathogenic bacteria, viruses, and fungi. This "acid barrier" protects the body from intestinal infections. However, when acidity decreases (hypochlorhydria, prolonged use of proton pump inhibitors), the risk of infection increases dramatically. For example, Clostridium difficile, salmonellosis, and other intestinal infections become more common.

3. The most common diseases and their importance

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INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
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Acute and chronic gastritis are among the most common diseases in the world. Helicobacter pylori infection is one of their main causes. Chronic gastritis is a precancerous condition that can lead to stomach cancer. Stomach and duodenal ulcer-acid-peptic disease. Stress, NSAID drugs, smoking and H. pylori together form a wound. Complications (bleeding, perforation, penetration, stenosis) are life-threatening. Gastroesophageal reflux disease (GERD) is the reflux of acid into the esophagus. This not only causes pain and burning, but also increases the risk of Barrett's esophagus and esophageal cancer. Functional dyspepsia-pain without organic changes, feeling full, nausea. This condition dramatically reduces the patient's quality of life. Gastroparesis is a severe complication of diabetes. The emptying of the stomach slows down, food is retained for a long time, leading to vomiting, pain, and nutritional disorders.

Stomach cancer is one of the most deadly diseases in the world, causing death. H. pylori, chronic atrophic gastritis, dietary habits (pickled, smoked foods), and genetic factors play a role.

4. Role in metabolism and the endocrine system

The stomach produces gastrin, ghrelin (the hunger hormone), somatostatin, serotonin, and other biologically active substances. Ghrelin stimulates the feeling of hunger and food intake. After bariatric surgery (gastric bypass), ghrelin levels decrease and the patient loses weight. The endocrine function of the stomach plays an important role in obesity, anorexia, and metabolic syndrome.

Conclusion

The stomach is one of the central and most important organs of the human digestive system. It not only performs the functions of temporary storage, mechanical and chemical breakdown of food, but also actively participates in protecting the body from infections, hormonal regulation, preparation of nutrient absorption, and overall metabolism. This article provides a detailed overview of the anatomical structure of the stomach (sections, wall layers, cells), physiological characteristics (secretory, motor, and endocrine functions), enzymes, acids, and clinical significance in the body. Normal stomach function ensures the health of the entire body. However, factors such as poor diet, stress, smoking, alcohol, NSAIDs, and Helicobacter pylori infection can disrupt stomach function and lead to serious diseases such as gastritis, peptic ulcer disease, dyspepsia, and even stomach cancer. Therefore, maintaining stomach health is an important issue for every person.

This article helps to understand the complex anatomical and physiological mechanisms of the stomach and serves as a basis for future in-depth research. In short, a healthy stomach is one of the key factors to a healthy life. Everyone should take care of their stomach by paying attention to their eating habits.

REFERENCES

1. Afanasyev Yu.I., Yurina N.A. Gistologiya, embriologiya, sitologiya. – M.: Medicina, 2018.
2. Drake R.L., Vogl W., Mitchell A.W.M. Gray's Anatomy for Students. – 4th ed. Elsevier, 2019.
3. Guyton A.C., Hall J.E. Tibbiy fiziologiya. – 13-nashr. – M.: MEDpress-inform, 2018.
4. Kovalyov A.I. Oshqozon va o'n ikki barmoq ichak kasalliklari. – Toshkent: Tibbiyot nashriyoti, 2020.
5. Kumar V., Abbas A.K., Aster J.C. Robbins Basic Pathology. – 10th ed. Elsevier, 2017.
6. O'zbekiston Respublikasi Sog'liqni saqlash vazirligi. Ichki kasalliklar: Ovqat hazm tizimi kasalliklari. – Toshkent, 2022.
7. Sherwood L. Human Physiology: From Cells to Systems. – 9th ed. Cengage Learning, 2015.

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 6. No 05. MAY ,2026

8. Sleisenger and Fordtran's Gastrointestinal and Liver Disease. – 11th ed. Elsevier, 2020.
9. Tortora G.J., Derrickson B. Principles of Anatomy and Physiology. – 15th ed. Wiley, 2018.
10. www.ncbi.nlm.nih.gov (PubMed), www.who.int va boshqa ilmiy elektron resurslar (2023–2026 yillar ma'lumotlari).