MINISTRY OF HEALTH OF UKRAINE

ODESSA NATIONAL MEDICAL UNIVERSITY

FACULTY OF MEDICINE

DEPARTMENT OF PHYSIOLOGY AND BIOPHYSICS

I APPROVE
Vice-rector for scientific and pedagogical work
_____ Eduard BURYACHKIVSKY
September 1, 2023

METHODICAL RECOMMENDATIONS FOR INDEPENDENT WORK OF HIGHER EDUCATION APPLICANTS IN THE ACADEMIC DISCIPLINE

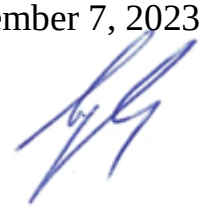
Faculty of Medicine, Second Course

Elective discipline "**Physiological Foundations of Rational Nutrition**"

2023

Approved:
Meeting of the Department of Physiology and Biophysics
Odessa National Medical University

Protocol No. 1 dated September 7, 2023

Head of the Department  Leonid GODLEVSKY

Developers:
(indicate the names, academic degrees, academic titles and positions of the developers; all those who
teach the specified academic discipline should be among the developers)

Olga KASHCHENKO, Candidate of Medical Sciences, Associate Professor of the Department of Physiology

Notes: In the case of publication of the Methodological Developments as an independent printed publication, the Academic Council of the Faculty provides a recommendation for publication in the presence of two reviews, one of which is external – from a reviewer of another higher education institution.
The department has the right to combine the topics of practical/seminar/laboratory classes in the form of methodological development for: (1) content modules; or (2) by year of study; or (3) by the entire discipline as a whole.

IW topic: Introduction to the course "Physiological Foundations of Rational Nutrition". Functions of food. Food history.

Purpose: to form future specialists' competencies in the field of modern physiological bases of nutrition processes, patterns of influence of food components on the state of health and functions of organs and systems.

Basic concepts:

Food is one of those important environmental factors that contributes to the preservation of health, resistance to harmful environmental factors, high physical, mental and mental performance, as well as active longevity. "Neither overeating, nor hunger, nor anything else, is good if one oversteps the measure of nature," said Hippocrates. Depending on what we eat, this is how we build our body, just like what building material is used, this is what a home is. Nutrition is a prerequisite for the existence of the body. **Proper nutrition** is the first key to health and well-being, without which it is difficult to achieve maximum performance. Prolonged fasting is not compatible with life, and malnutrition leads to certain disorders in the body. With improper nutrition, children grow and develop poorly, adults often get sick, get tired quickly, work unproductively, and age prematurely. The main disorders in nutrition are observed in different age and professional groups with almost with the same frequency. First of all, it is an excess of carbohydrates and fats of animal origin in food and a deficiency of vegetables, fruits and berries. When treating overweight patients, first of all, it is necessary to determine the cause of its occurrence. Among the causes are burdened heredity, disorders of the endocrine (menopausal period, etc.) and central nervous system (concussion, etc.), overeating, physical inactivity, bulemia (especially harmful for people aged 30 years and more), treatment tactics depend on this. The most significant changes come from a violation of the diet. It should be noted that a significant part of people eat incorrectly, do not eat on time, do not pay attention to the quality of food, eat less or consume food excessively, abuse alcohol, smoke, use drugs, etc. **Rational nutrition** is physiologically complete nutrition of potentially healthy people, that is, one that provides the human body with the optimal amount of nutrients and energy in accordance with the norms of the physiological needs of the human body, taking into account gender, age, physical activity, for the nature of the disease and its course and other factors. Short-term errors ("zigzag") in the mode and quality of nutrition of healthy people do not always contribute to the development of the disease, and in patients contribute to the exacerbation of the disease. When the disease develops, questions arise: can the patient consume any food and is it possible to improve health and recover by selecting food? The answers to these questions are given by the science of diet therapy. The science of nutrition of a healthy and sick person is called dietetics. Its history is as old as the history of mankind. It has developed significantly only in the last 100-150 years. **Dietary nutrition** for patients is prescribed by a rehabilitation doctor, who recommends which food should be consumed and which should be excluded from the diet. But there are often additional questions, the answers to which can be found in our guide. Nutrition should be considered not only as an individual element of ensuring the full life and health of each person, but also as an important component of public health. After all, in modern realities, the first and most important problem of the public The burden of chronic non-communicable diseases (diabetes, cancer, cardiovascular diseases, chronic respiratory diseases), which cause more than 2/3 of the total morbidity and about 86% of deaths in Ukraine, has been determined. It is possible to influence public health only through the joint efforts of the state, the public and the individual. But in a broad sense, the greatest contribution can be made through the investment of time, money and money in it. One of the most important means is a rational diet.

Equipment: textbooks, manuals, guidelines on the topic of the seminar, multimedia projector, laptop, interactive whiteboard.

Plan:

1. *Organizational measures:*
   - Greeting
   - checking attendees,
   - communication of the topic, purpose of the lesson,

- motivation of higher education students to study the topic.

2. *Control of the basic level of knowledge:*
   - Written work
   - written testing,
   - Frontal survey on basic terminology
3. Questions (test tasks) to test basic knowledge on the topic of the seminar:

1. In the early stages of human development, nutrition was:
a) the variety of products that nature has given them;
b) meat;
c) fish;
d) vegetables;
e) fruits

2. The first humanoid creatures (appeared on our planet about 3 million years ago) used:
(a) the remains of prey from wild animals;
b) wild plants, larvae, worms;
c) vegetables;
d) fruits;
e) fish

3. What was the result of feeding on the remains of animals of primitive humanoid creatures?
a) to various infectious diseases;
b) changes in the alimentary canal depending on the nature of nutrition;
c) changes in the immune system;
d) changes in the cardiovascular system;
e) changes in the endocrine system

4. What kind of food did Cro-Magnons eat (about 40,000 years ago)?
a) mainly meat;
b) vegetables;
c) fruit;
d) fish;
e) mixed meals

5. In the process of evolution, Cro-Magnons began to use:
(a) raw meat of small animals;
b) plant roots;
c) herbs;
d) fruits, berries;
e) all of the above

6. In the next period of life during excavations, archaeologists found in the remains of food:
(a) Fish;
b) crayfish;
c) molluscs;
d) meat of animals and wild plants;
e) all of the above

7. The discovery of fire (about 100 thousand years ago) made it possible to:
a) to expand the range of products of plant and animal origin through heat treatment;
b) increase the nutritional value of products;
c) improve the palatability of products;
d) reduce the number of infectious diseases;
e) all of the above

8. What changes have occurred in human nutrition about 10 thousand years ago? years ago (the era of agriculture) ?
a) consumption of grown plants;
b) consumption of cereals, flax;
c) consumption of vegetables, fruits;
d) eating meat of domesticated animals;
e) all of the above is true

9. In the Bronze Age (about 4 thousand years ago), with the beginning of the era of arable land use, in the process of nutrition, the following are consumed:
a) horticultural products (onions, garlic, etc.);
b) horticultural products (plums, cherries, etc.);
c) cultivation of wheat, production of bread;
d) consumption of berries;
e) all of the above

10. At the end of the sixteenth century. In Europe, they began to consume:
a) potatoes;
b) sugar from beets;
c) sunflower oil;
d) tomatoes;
e) all of the above

11. Differences in the diet of modern man and man in the cave period:
a) cavemen did not know breakfast, lunch, dinner;

b) people in the cave period consumed food when it was available;
c) in the cave period, people ate once a day;
d) in the cave period, people ate every other day;
e) All of the above is true.

4. Discussion of theoretical issues: in the form of answers to questions, disputes, discussions, presentations, abstracts, discussion of reports and abstracts, reviewing the answers of higher education applicants, etc.

Even in ancient manuscripts, which are the primary sources for the study of the history of medicine, there are mentions that Egyptian doctors (priests) attached great importance to nutrition as a prophylactic and therapeutic agent. A description of the first diets is given in the Salerno Health Code (1480). Hippocrates indicated that food substances should be a remedy and remedies should be nutritional substances. The problem of nutrition was dealt with by: Bacon, C. Darwin, I. Mechnikov, I.M. Sechenov, N.M. Pirogov, I.P. Pavlov and other famous scientists and doctors of that time. Later, a book by the famous English nutritionist John Yudkin "Pure, White and Deadly" was published. But by the end of the nineteenth century. Therapeutic nutrition has been used empirically. Only with the discovery of the laws of digestion by Academician I.P. Pavlov, dietary nutrition acquired scientific justification. In the 20-50s of the twentieth century. M.I. Pevsner developed the so-called group diet system, according to which each group of related diseases received its own diet. Today, there is an opinion that this division is not only outdated, but also causes some harm. After all, prescribing a diet to a patient to feed one disease can negatively affect the development of concomitant diseases in him. Initially, there were 15 diets, which were widely prescribed to patients in hospitals, sanatoriums, and dietary canteens. The main difference between modern recommendations for human nutrition is that it is based on four main components: adequacy to energy expenditures, balance in the content of the most important products and nutrients, food safety and the maximum possible preservation of the pleasure of its consumption. At the same time, the diet of a sick person should include these four components as much as possible. Patients should not be grouped "around - 10 - diet tables" on the basis of their own illness. Taking into account the fact that the basis of nutrition of any person should be physiologically complete nutrition, the approach to the nutrition of patients should be based on the formation of a healthy diet with individual settings, taking into account the rejection of certain products and the characteristics of the existing disease. The proposed methodological recommendations are based on the results of those scientific works related to the study of diets of certain groups of the population, as well as the "CINDI Program Guidelines on Nutrition" and WHO recommendations. Dietary nutrition. Dietetics as a science of the basics of nutrition of a healthy and sick person originated in the distant past. Diet is the diet and diet of a healthy and sick person. The diet should be adapted to the metabolic processes disturbed during the disease, spare the damaged organ and take into account the disturbed functions. To do this, select certain food products that have undergone special heat treatment. Diet therapy is therapeutic nutrition. It is used for therapeutic or prophylactic purposes. As a rule, diet therapy is prescribed in combination with medications and other therapeutic measures. For some diseases, such as the digestive system, diet therapy is the main method of treatment. Dietary products. Each food product has only its characteristic nutritional and biological value, which is determined by organoleptic and gastronomic qualities, chemical composition, digestibility of nutrients, energy value. Dietary products are conventionally divided into two groups. The first group is used for diseases of the gastrointestinal tract, disorders of the act of chewing and swallowing and in the postoperative period; The second group – for diseases associated with metabolic and energy disorders (atherosclerosis, diabetes mellitus, renal failure, obesity, etc.). Nutrition is the consumption of food products in accordance with the physiological (dietary) needs of the body. Rational nutrition is physiologically complete nutrition of potentially healthy people, that is, one that provides the human body with the optimal amount of nutrients and energy in accordance with the norms of the physiological needs of the human body. - 11 - A healthy diet, as an element of a healthy lifestyle, involves an optimal ratio of rationally organized nutrition in combination with regular physical activity. Nutrition, due to its functions and biological effects: 1) ensures the growth and development of the younger generation; 2) forms a high level of health; 3)

restores working capacity; 4) increases life expectancy; 5) reduces the level of alimentary diseases and the most important non-communicable diseases with alimentary risk factors; 6) contributes to the protection of the population from the impact of unfavorable production and environmental conditions; 7) contributes to recovery and prevention of disease recurrence. The priority areas of modern nutrition science include the organization of a rational balanced diet; prevention of alimentary diseases associated with deficiency of protein, micronutrients, and other essential nutritional factors; raising public awareness of healthy eating. The scientific basis for the organization of rational nutrition of a person,, regardless of his age, gender, state of health and professional affiliation, is the general physiological and hygienic requirements for the diet, diet and conditions of food intake. Rational nutrition is based on the following principles: 1) the principle of quantitative adequacy – the correspondence of the energy value of the diet of young people and adults to the energy expenditure of the body; 2) the principle of qualitative completeness – enrichment of the diet with all the nutrients necessary for plastic purposes and regulation of physiological functions; 3) the principle of balance – the balance of the diet in terms of nutrient content; 4) the principle of optimality – compliance with the diet; 5) the principle of adequacy – the correspondence of the chemical composition of food, its assimilation and digestion to human metabolic processes; (6) the pleasure principle; 7) the principle of safety. To date, there is a common table, a postoperative table and a table where products that are not recommended for the patient are highlighted.

5. Topics of reports / abstracts: when preparing a report, abstract, analytical review, etc., students can, along with this, prepare didactic visual materials in the form of tables, codegrams, slides, drawings, drug diagrams, etc.:
   - Physiological characteristics of basic foods and their role in maintaining homeostasis;
   - Functions of food. Energy and plastic needs of the physiological functions of the human body;
   - Physiological characteristics of basic foods;
   - The importance of water, salt, animal and plant products in human nutrition.
6. Summing up.
7. Recommended Reading List:

Main:

1. Costanzo L. S. Physiology / L. S. Costanzo. - Elsevier Health Sciences. - 7th ed., 2021. - 528 p.
2. Ganong's Review of Medical Physiology / K. E. Barrett, S. M. Barman, H. L. Brooks., J. Yuan, - McGraw Hill Medical. – 26th edition, 2019. –752 p.
3. Guyton A. Textbook of Medical Physiology / A. Guyton, J. E. Hall. - Elsevier. - 14th Edition, 2021. – 1820 p.

Additional

4. Koeppen B. M. Berne and Levy Physiology / B. M. Koeppen, B. A. Stanton. - Elsevier Health Sciences. - 8th edition, 2023. – 864 p.
5. Sembulingam K. Essentials of Medical Physiology / K. Sembulingam, P. Sembulingam. – Jaypee Brothers Medical Publishers. – 9th ed., 2022. –1022 p.

Electronic Information Resources

1. Official website of the Department of Physiology of ONMedU https://info.odmu.edu.ua/chair/physiology/files
2. Testing Center – Krok-1 Licensed Test Items Database https://www.testcentr.org.ua/uk/
3. National Scientific Medical Library of Ukraine http://library.gov.ua/
4. V.I. Vernadsky National Library of Ukraine http://www.nbuv.gov.ua/
5. Ministry of Health of Ukraine: official website. URL: https://moz.gov.ua/.
6. National Health Service of Ukraine: official website. URL: https://nszu.gov.ua/pro-nszu
7. National Academy of Medical Sciences of Ukraine. URL: www.amnu.gov.ua.
8. World Health Organization - www.who.int
9. Regional Office for Europe of the World Health Organization. URL: www.euro.who.int

10. European Health for All Database. URL: http://medstat.gov.ua/ukr/statreports.html.
11. Medical Information System: official website of the Med-Expert company. URL: http://medexpert.ua/ua/medichnij-zaklad/31-medichnij-zaklad/pro-rynku-v-iznoho-medychnoho-turyzmu-v-ukraini
12. Ukrainian Medical Journal: Medical Journal. URL: www.umj.com.ua.
13. Medical World: Professional Newspaper. URL: www.medsvit.org.
14. Ukrainian Medical Council. URL: http://www.medicalcouncilukraine.org.
15. Global Health Expenditure Database. URL: https://apps.who.int/nha/database/ViewData/Indicators/en
16. Health Strategy. European Commission: official web-site. URL: https://ec.europa.eu/health/policies/background/review/strategy.
17. Global health security Index. URL: https://www.ghsindex.org/about/

IW topic: Physiological bases of digestion and assimilation of food.
Objective: to form future specialists' competencies in the field of modern physiological bases of digestion, nutrition, patterns of influence of food components on health and functions of organs and systems.
Basic concepts:

Digestion is the process of physical and chemical processing of food, as a result of which it becomes possible to absorb nutrients through the walls of the digestive tract and enter the blood or lymph. In the digestive apparatus, complex physicochemical transformations of food take place: from the formation of a food lump in the oral cavity to the absorption and removal of its undigested residues. These processes are carried out as a result of the motor, absorptive and secretory functions of the digestive apparatus. The physical processing of food takes place in oral cavity. Such processing includes crushing and dissolving food particles, as well as the formation of a food lump. After grinding and grinding with the teeth, the food is subjected to the hydrolytic action of the enzymes of the salivary glands. The ducts of three groups of glands open into the oral cavity: mucous, serous and mixed. Saliva has pronounced bactericidal properties. They are caused by salivary lysozyme, an enzyme that dissolves the bacterial membrane. Motor impulses from the swallowing center along the efferent branches of the trigeminal, hypoglossal, vagus and glossopharyngeal nerves are transmitted to the muscular apparatus **of the oral cavity** - the larynx and pharynx. As a result of the sequential contraction of these muscles, the food ball enters the esophagus.

Methods of studying the thresholds of taste sensitivity: There are four "primary" taste sensations: sweet, sour, salty, bitter. The taste threshold is the minimum concentration of the test substance that causes the sensation of taste. The lowest thresholds of taste sensitivity are for bitter taste. Thresholds of taste sensitivity depend on the state of the body (starvation, pregnancy); Alcohol and nicotine increase taste thresholds. Sweets lovers have a threshold for sweets Increases. A drop of any of the listed substances is applied to the tip of the subject's tongue (without touching it) from a pipette and asked to take a sip. Studies start with the lowest concentration of the substance (0.001%) and increase it until the subject accurately determines the taste of the substance applied to the tongue. The found concentration is taken as the threshold of taste sensitivity for this substance. After testing each solution, the mouth is rinsed with water, after which the study of the new concentration of the substance begins. It is desirable to carry out the experiment on several subjects.

Methods of studying **the taste fields of the tongue** The subject sequentially on different parts of the tongue (tip, root, lateral sections, back), without touching the mucous membrane, apply a drop of any of the listed substances from a pipette. Make sure that chemical stimuli cause basic taste sensations of bitter, salty, sour or sweet. After each application, rinse the oral cavity with water. It is desirable to conduct the experiment on several subjects. Sense of taste denoted as "+", the absence of taste sensation as "–". Compare the sensitivity of different parts of the mucous membrane of the tongue to different stimuli. If there are differences, then explain what they are related to.

Method of studying the digestive effect of **saliva on starch**: the subject rinses his mouth. 6 ml of saliva is collected from it. It is poured into 3 test tubes and numbered. Saliva in test tube No. 2 is boiled in an alcohol bottle. Then 2 ml of boiled starch is added to test tubes No. 1 and No. 2. Raw starch is added to test tube No. 3. All test tubes are placed in a water bath at a temperature of 38 °C for 1 hour, After that, the contents of the tubes are divided into two parts. Lugol's solution (reaction to starch) is added to the first part of the contents of each of the tubes. The second part of the contents of each of the tubes is brought to a boil with Fehling's reagents (reaction to maltose). In the case of the presence of simple sugars in the solution, brownish-red copper oxide is formed. It is desirable to carry out the experiment on several subjects.The presence of simple sugars in the solution is denoted as "+", the absence - as "-".

Technique for conducting a qualitative **saliva test for mucin content**: the subject rinses his mouth. 2 ml of saliva is collected in it and placed in a test tube, then a few drops of a 10% acetic acid solution are added there and the reaction is observed. If there is mucin in the saliva, it precipitates.

In the stomach, chemical transformations of nutrients occur under the influence of proteases, lipases and hydrochloric acid. (Proteolytic enzymes - pepsinogens (pepsin and gastrixin) - break down

proteins into polypeptides of varying complexity. Gastric juice lipases break down fats into glycerol and fatty acids. Gastric juice contains gastromucoprotein, which ensure the passage of certain substances through the walls of the stomach.

Digestion is a preparatory stage of metabolism: mechanical processing, enzymatic breakdown and absorption of nutrients. Mechanical processing (crushing, chewing) of food, the formation of a food lump and partial enzymatic breakdown occur in the oral cavity. In the stomach, proteins and fats are enzymatically broken down.

In the intestine, the breakdown of proteins into amino acids, fats into glycerol and fatty acids, carbohydrates into monosaccharides is completed. The completion of the enzymatic breakdown of nutrients is the result of the effect of highly active enzymes of the pancreas and intestinal glands on them. The highest activity of enzymes is during contact (parietal) etching. The absorption of nutrients completes the digestive function. It is carried out on a huge area of microvilli - the thinnest protoplasmic outgrowths of intestinal epithelial cells.

In the regulation of digestive function, a special role is played by conditioned reflex mechanisms, comprehensively studied by I. P. Pavlov. The mechanisms of humoral regulation are closely related to the hormonal function of the stomach, small intestine and pancreas. A special role in the production of tissue hormones - regulators of the activity of the digestive glands, liver and pancreas - belongs to the duodenum. The hypothalamus is the highest subcortical center for the regulation of digestive function and the formation of eating behavior.

Interpretation of gastric juice test results

1. **Amount of gastric juice**: normal value **20-100 ml** after a 12-hour fast. Factors influencing the result - atropine, ganglion blockers, insulin, diazepam, 5-hydroxytryptamine reduce the rate of secretion. Diagnostic value: the amount increases with delayed gastric emptying, increased secretion of gastric juice (duodenal ulcer, Solinger-Ellison syndrome), regurgitation with DPC.
2. **Organoleptic characteristics** (consistency, color, smell, bile): normal values - the juice is liquid, may be slightly viscous, colorless, the smell is sour, there may be bile. Diagnostic value: bile may be seen after gastrectomy, gastroenterosomy, or regurgitation. With stomach cancer, ulcers, gastritis, blood may be observed (in the presence of HCl, hematin is formed, resembling coffee grounds. Fresh red blood appears as a result of trauma or bleeding from the stomach wall (ulcer, cancer).
3. **Free hydrochloric acid** (determined by titrimetry): normal value - without stimulation - **up to 40 mmol/l**, in 4% of healthy people and 25% of people over 60 years of age, free hydrochloric acid may be absent without stimulation. Factors influencing the result - caffeine, calcium salts, ACTH, ethyl alcohol, Rauwolf preparations increase acidity. Acetazolamide, atropine, diazepam, ganglion blockers, glucagon, insulin, propanolol, secretin, 5-hydroxytryptamine reduce acidity. Diagnostic value: increases in duodenal ulcers, some cases of gastric ulcers, Solinger-Ellison syndrome. Free hydrochloric acid is absent in pernicitous anemia. To confirm the diagnosis of achlorhydria, it is necessary to determine the maximum stimulation, since false achlorhydria is possible as a result of neutralization of hydrochloric acid by food or with regurgitation of alkaline juice from the intestine.
4. **Total acidity** (determined by titrimetry): normal value - **10 -150 mmol/l**. Factors influencing the result - caffeine, calcium salts, ACTH, ethyl alcohol, Rauwolf preparations increase acidity. Acetazolamide, atropine, diazepam, ganglion blockers, glucagon, insulin, propanolol, secretin, 5-hydroxytryptamine reduce acidity. Diagnostic value: increases in duodenal ulcers, some cases of gastric ulcers, Solinger-Ellison syndrome. Free hydrochloric acid is absent in pernicitous anemia.
5. **pH - Measurement** - Normal value: **1,5 - 3,5.** Factors influencing the result - caffeine, calcium salts, ACTH, ethyl alcohol, Rauwolf preparations increase acidity. Acetazolamide, atropine, diazepam, ganglion blockers, glucagon, insulin, propanolol, secretin, 5-hydroxytryptamine reduce acidity. Diagnostic value: increases in duodenal ulcers, some cases of gastric ulcers, Solinger-Ellison syndrome. Free hydrochloric acid is absent in pernicitous anemia. To confirm the diagnosis of achlorhydria, it is necessary to determine the maximum stimulation, since false achlorhydria is possible as a result of neutralization of hydrochloric acid by food or with regurgitation of alkaline

juice from the intestine.

6. Secretion rate:

Basal secretion: normal value **0-5 mmol/h**. Factors influencing the result - atropine, ganglion blockers, insulin, diazepam, 5-hydroxytryptamine reduce the rate of secretion. Diagnostic value: <5 mmol/hour may be observed in some patients with gastric ulcers. Values of 5 to 15 mmol/hour occur in duodenal ulcers. Values of >20 mmol/hour (60) are characteristic of Solinger-Ellison syndrome (gastrinoma).

Peak and maximum secretion: normal value **5-20 mmol/hour**. Peak secretion is calculated based on the two maximum values obtained by analyzing samples for 15 minutes. Maximum acid secretion is calculated based on the analysis of the first 4 samples within 15 minutes obtained after stimulation. Since in some patients the maximum secretion is not reached earlier than 1 hour after stimulation, It is better to determine peak secretion. Factors influencing the result - atropine, ganglion blockers, insulin, diazepam, 5-hydroxytryptamine reduce the amount of secretion. Diagnostic value: values of 20-60 mmol/hour occur in healthy, in patients with duodenal ulcers, stomach, with Solinger-Ellison syndrome. Values of >60 mmol/h are a reliable sign of Solinger-Alison syndrome. The absence of an increase in secretion is noted in patients with prnicitous anemia: reduced secretion is noted in some patients with gastric ulcers, stomach cancer, chronic gastritis.

Basal secretion / peak secretion ratio: normal value <0.2 (20%). Factors influencing the result - atropine, ganglion blockers, insulin, diazepam, 5-hydroxytryptamine reduce the amount of secretion. Diagnostic value: values < 0.2 can also be observed in patients with ulcers or stomach cancer, 0.2-0.4 in gastric ulcers and duodenal ulcers. With a duodenal ulcer or Solinger-Ellison syndrome, values of 0.2-0.4 are observed, and a value of > 0.6 is a characteristic sign of the syndrome Solinger-Alison.

Equipment: textbooks, manuals, guidelines on the topic of the seminar, multimedia projector, laptop, interactive whiteboard.

Plan:

Organizational measures:

- Greeting
- checking attendees,
- communication of the topic, purpose of the lesson,
- motivation of higher education students to study the topic.

Control of the basic level of knowledge:

- Written work
- written testing,
- Frontal survey on basic terminology

Questions (test tasks) to test basic knowledge on the topic of the seminar:

1. The person underwent gastrectomy with removal of the pyloric section. What processes in the gastrointestinal tract were disrupted?
A. Transition of chyme to WPC
Перистосика интекущиIntestinal peristalsis
C. Suction in WPC
Secretion of juice in DPKekSecretion of juice in WPC
E. All answers are correct

2. Part of the person's stomach has been removed. What kind of diet should she follow?
Take food at nightTake food at night
B. In large portions twice a day
C. Normal diet three times a day
D. In small portions 6–8 times a daySmall portions 6–8 times a day
Take food during lunch 1 time

3. For a person with hypersecretion of gastric juice, the doctor recommended excluding rich broths and vegetable decoctions from the diet, since they contain substances that stimulate gastric secretion. That?
A. Hydrochloric acid
Extractives and histamineExtractives and histamine
C. Large amount of carbohydrates
Large amount of fatsLarge amount of fats
E. Gastrin

4. For a person with hypersecretion of gastric juice, the doctor recommended excluding rich broths and vegetable decoctions from the diet, since they contain substances that stimulate gastric secretion mainly by the following mechanism:
Stimulate the production of secretin in WPCStimulate the production of secretin in WPC
Irritating taste buds
Irritating mechanoreceptors of the oral cavityIrritating mechanoreceptors of the oral cavity

Irritating the mechanoreceptors of the stomachIrritating the mechanoreceptors of the stomach
Stimulate the production of gastrin

5. A person needs to perform gastric probing to examine gastric secretion. Under these conditions, a trial breakfast is given. Which of the following products should not be used?
A. Salo
Гистамин
C. Rusks
D. Alcohol
Cabbage juice

6. During swallowing, a person has changes in the motor activity of the stomach. Which of the following characterizes the condition of the stomach during swallowing and immediately after it?
Повышения перистальсиIncreased peristalsis
B. Speeding up evacuation
C. Food receptive relaxation
Decrease in the rhythm of contractionsDecrease in the rhythm of contractions
Decrease in the amplitude of contractionsDecrease in the amplitude of contractions

7. Gastric surgery, the purpose of which is selective vagotomy, is used in the following conditions:
Hypoacid gastritis
Atrophic gastritis
Gastrointestinal gastritis
Ulcer of the stomach
Cancer of the stomach

8. It is known that the synthesis of HCl by parietal cells of the gastric mucosa occurs with the participation of secondary messengers:
A. Adenylate cyclases (cAMP)
B. Guanylate cyclases (cGMP)
C. Ionized Ca++
Inositol-triphosphate
Calmodulin

9. A two-month-old baby who is bottle-fed has periodic regurgitation. Violation of the functioning of which enzyme can be assumed?
Cathepsin of salivaSaliva cathepsin
Кажного катепсинGastric cathepsin
C. Renin (peptidases D)
Trypsin
Carboxypeptidase A

10. The patient was found to have damage to additional cells of the gastric mucosa and a violation of the mucose-bicarbonate barrier. This can cause the development of:
Atrophic gastritis
Gastrointestinal reflux
Hypoacid gastritis
Hyperacid gastritis
Ulcers of the stomach

Answers: 1.A, 2.D, 3.B, 4.E, 5.A, 6.C, 7.D, 8.A, 9.C, 10.E.

Discussion of theoretical issues: in the form of answers to questions, disputes, discussions, presentations, abstracts, discussion of reports and abstracts, reviewing the answers of higher education applicants, etc.

- Describe the structure and function of the digestive system.
- Describe the mechanisms of digestion in the oral cavity.
- Describe the act of chewing, its center of regulation.
- Describe the act of swallowing, its center of regulation.
- List the main components of the composition of saliva, its role in digestion.
- Describe the mechanism of primary and secondary saliva production.
- List the mechanisms of regulation of salivation. The influence of the properties of the stimulus on the quantity and quality of saliva.
- Structural and functional organization of the taste sensory system.
- Types of taste sensitivity, mechanisms of its perception, their physiological role and research methods.
- Receptor, conduction and cortical sections of the olfactory analyzer.
- Classification of odors, theories of their perception.
- Composition and properties of gastric juice.
- Mechanism of formation of hydrochloric acid.
- Methods of studying the secretory function of the stomach in humans.
- Phases and types of regulation of gastric secretion, their adaptive changes.
- Nervous and humoral mechanisms of inhibition of gastric secretion.
- Motor function of the stomach, mechanisms of transition of gastric contents to the duodenum and their regulation.

Topics of reports / abstracts: when preparing a report, abstract, analytical review, etc., students can, along with this, prepare didactic visual materials in the form of tables, codegrams, slides, drawings, drug diagrams, etc. Thus, for example, "Physiological characteristics of basic foods and their role in

the maintenance of homeostasis (importance of water, edible salt, animal and vegetable products)".
Summing up.
Recommended Reading List:
Main:

1. Costanzo L. S. Physiology / L. S. Costanzo. - Elsevier Health Sciences. - 7th ed., 2021. - 528 p.
2. Ganong's Review of Medical Physiology / K. E. Barrett, S. M. Barman, H. L. Brooks., J. Yuan, - McGraw Hill Medical. – 26th edition, 2019. –752 p.
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- National Academy of Medical Sciences of Ukraine. URL: www.amnu.gov.ua.
- European Health for All Database. URL: http://medstat.gov.ua/ukr/statreports.html.

IW topic: The impact of nutrition on the functioning of internal organs and systems.
Objective: to form future specialists' competencies in the field of modern physiological bases of digestion, nutrition, patterns of influence of food components on health and functions of organs and systems.
Basic concepts:

In the intestine, food masses (chyme) are subjected to the hydrolytic action of proteases, lipases, carbohydrases and other enzymes, as well as mechanical mixing. The contraction of the circular and longitudinal muscles of the small intestine contributes to the movement of the food ball.

The contraction of the circular and longitudinal muscles is regulated by the vagus and celiac nerves. The mechanical function of the intestines is influenced by humoral factors. In particular, choline, enterocrinin, and serotonin stimulate intestinal movement. The most active role in intestinal digestion is played by pancreatic enzymes, bile and the intestinal juice itself, secreted by the glands of the intestinal mucosa.

In the duodenum, the food masses that come from the stomach are exposed to proteolytic enzymes, lipases, carbohydrases and nucleases. Bile plays a special role in intestinal digestion.

Digestion processes end in the large intestine. In the large intestine, carbohydrates are fermented and proteins rot under the influence of bacteria. In the large intestine, the active absorption of water is completed.

In the small intestine, the breakdown of proteins into amino acids, fats into glycerol and fatty acids, carbohydrates into monosaccharides is completed. The completion of the enzymatic breakdown of nutrients is the result of the effect of highly active enzymes of the pancreas and intestinal glands on them. The highest activity of enzymes during contact (parietal) digestion

The absorption of nutrients completes the digestive function. It is carried out on a huge area of microvilli - the thinnest protoplasmic outgrowths of intestinal epithelial cells.

In the regulation of digestive function, a special role is played by conditioned reflex mechanisms, comprehensively studied by I. P. Pavlov. The mechanisms of humoral regulation are closely related to the hormonal function of the stomach, small intestine and pancreas. A special role in the production of tissue hormones - regulators of the activity of the digestive glands, liver and pancreas - belongs to the duodenum. The hypothalamus is the highest subcortical center for the regulation of digestive function and the formation of eating behavior.

Equipment: textbooks, manuals, guidelines on the topic of the seminar, multimedia projector, laptop, interactive whiteboard.
Plan:
Organizational measures:
- Greeting
- checking attendees,
- communication of the topic, purpose of the lesson,
- motivation of higher education students to study the topic.

Control of the basic level of knowledge:
- Written work
- written testing,
- Frontal survey on basic terminology

Questions (test tasks) to test basic knowledge on the topic of the seminar:

1. After the introduction of leptins into the blood of rats, a decrease in the activity of the hypothalamic nuclei was recorded:
Lateral
Ventromedial
Supraoptic
Paraventricular
Задых

2. As a result of diarrhea, hypokalemia has occurred, indicating a loss of potassium from:
Stomach
Панетической сыкPancreatic juice
C. WPC

Данный пустычный intestineEmpty intestine
E. Colon

3. Under conditions of hypersecretion of hydrochloric acid by parietal cells of the gastric glands, an inhibitor of the ATPase enzyme was used, which led to inhibition of the hydrogen pump and a decrease in the secretion of hydrogen ions. At the same time, the active transport of one of the ions through the apical membrane of cells decreased:
Sodium
Chlorine
Potassium
D. NSO-
E. NRA42-

4. After DPC resection, absorption into the blood was significantly reduced:
Колосы
Lipids
Amino acids
Sodium
Chlorine

5. Under conditions of hyposecretion of hydrochloric acid by the gastric glands, it became impossible to absorb in the colon:
Sodium
Chlorine
Вылычный ожилкиBile acids
Vitamin B12
Vitamin C

6. Violation of membrane digestion as a result of changes in the morphological structure of the epithelium will lead to impaired hydrolysis and absorption of:
Lipids
B. Carbohydrates
Vitamin A
Vitamin D
Зализа
7. After consuming the broth, the proteolytic activity of the pancreatic juice increases during the intestinal phase due to the stimulation of acinar cell secretion:
A. Gastrin
B. Secretin
Cholecystokinin
Vasoactive intestinal peptideVasoactive intestinal peptide
Acetylcholine

8. After the introduction of a hypertonic salt solution into the digestive tract, the laxative effect is due to the stimulation of intestinal motility:
Metasympathetic reflexes
Cholecystokinin
C. Motilin
D. Secretin
Bile acids

9. After gastrectomy, the digestive processes were affected, first of all, by the absence of:
Hydrolysis of proteinsHydrolysis of proteins
Hydrolysis of fatsHydrolysis of fats
Hydrolysis of carbohydrates
D. Depositing food
Rhythmic segmentation

10. During lunch, among other dishes, it is customary to eat borscht, since it contains substances that stimulate secretion in the gastric phase:
Histamine
B. Gastrin
C. Secretin
Acetylcholine
Motilin

Answers: 1.A, 2.E, 3.C, 4.B, 5.D, 6.B, 7.C, 8.A, 9.D, 10.B.

Discussion of theoretical issues: in the form of answers to questions, disputes, discussions, presentations, abstracts, discussion of reports and abstracts, reviewing the answers of higher education applicants, etc.

- Describe the role of the liver in digestion.
- Describe the mechanisms of bile formation and bile secretion.
- Describe the role of bile in digestion.
- Composition and properties of hepatic and vesicular bile.
- Describe the mechanisms of regulation of bile formation and secretion in the DPC.
- Methods for the study of bile secretion in humans.
- Describe the secretory function of the pancreas.
- Describe the composition, properties, and amount of pancreatic juice.
- Describe the role of pancreatic juice in digestion.
- Nervous and humoral regulation of pancreatic secretion.
- The phases of regulation of pancreatic secretion are cephalic, gastric, and intestinal.
- Methods for studying the secretion of pancreatic juice in humans.

Topics of reports / abstracts: when preparing a report, abstract, analytical review, etc., students can, along with this, prepare didactic visual materials in the form of tables, codegrams, slides, drawings, drug diagrams, etc. Thus, for example, "Physiological characteristics of basic foods and their role in the maintenance of homeostasis (importance of water, edible salt, animal and vegetable products)". Summing up.

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- Ministry of Health of Ukraine: official website. URL: https://moz.gov.ua/.

IW topic: Energy and plastic needs of physiological functions of the human body.
Objective: to form future specialists' competencies in the field of modern physiological bases of digestion, nutrition, patterns of influence of food components on health and functions of organs and systems.
Basic concepts:
There is a continuous exchange of matter and energy between the body and the environment. **Metabolism is a complex chain of transformations of substances in the body, starting from the moment they come from the external environment and ending with the removal of decay products.** Metabolism begins with the intake of water and food into the body. In the alimentary canal, some of the substances are broken down by enzymes into simpler ones, which are absorbed in the intestines and pass into the blood (and with the blood the substances are transferred to the cells of the body). In cells, the processes of their chemical transformations (cellular metabolism) take place, during which the body receives the energy and materials it needs to build its own cells and tissues. Residues and waste products (decay products) are excreted from the body (with urine, feces, sweat and exhaled air).
Plastic and energy metabolism

Metabolism in the body is not just a constant flow of substances through its basic structures, but the totality of all chemical reactions that take place in the body. All reactions associated with the transformation of substances can be attributed to two processes: **plastic** and **energy** metabolism.
Plastic metabolism (assimilation, or anabolism) is a set of reactions for the synthesis of organic substances in a cell using (expending) energy.

In the processes of energy metabolism (dissimilation, or catabolism, or biological oxidation), the destruction (disintegration) of nutrients obtained with food into simple compounds occurs with the release of energy of chemical bonds of organic food molecules.

In a healthy organism, both processes are clearly balanced (although during a period of rapid growth, assimilation may temporarily prevail over dissimilation).

The set of all reactions related to metabolism (enzymatic chemical reactions) in the body is called metabolism.
The main types of metabolism are **protein**, **carbohydrate**, **fat** and **water-salt** metabolism.

Equipment: textbooks, manuals, guidelines on the topic of the seminar, multimedia projector, laptop, interactive whiteboard.
Plan:
Organizational measures:
- Greeting
- checking attendees,
- communication of the topic, purpose of the lesson,
- motivation of higher education students to study the topic.

Control of the basic level of knowledge:
- Written work
- written testing,
- Frontal survey on basic terminology

Questions (test tasks) to test basic knowledge on the topic of the seminar:

1 The respiratory quotient is:
A. Ratio of the volume of CO2 emitted to the volume of absorbed O2
B. Ratio of the amount of absorbed O2 to the amount of CO2 released
C. Ratio of the amount of CO2 emitted to volume of absorbed O2
D. Ratio of the volume of absorbed O2 to volume of CO2 emitted
The ratio of the amount of absorbed O2 to the amount of released O2

2. The respiratory coefficient can be greater than 1:
A. In the first 5 minutes after the end of physical activity
B. 1 hour after physical exertion
C. Under Stress
D. Under conditions of fasting
E. In diabetes mellitus

3. By the method of indirect calorimetry, it was found that the basal metabolism of the study subject is 15% lower than it should be. Disruption of which endocrine gland can be assumed?
A. Hypothalamus
B. Pituitary
C. Pancreas
D. Thyroid gland
E. Sex hormones

4. The excretion of 1 g of nitrogen by the body corresponds to the breakdown of the following amount of protein in the body:
A. 5.25 g
B. 5.75 g
C. 6.00 g
D. 6.25 g
E. 6.50 g

5. For an adult weighing 70 kg, the protein minimum is:
25 g of protein per day25 g of protein per day
40 g of protein per day40 g of protein per day
C. 52 g of protein per day
75 g of protein per day
100 g of protein per day

6. The actual basic exchange is determined by:
По объектию хранных oxygenAccording to the amount of oxygen absorbedBy the amount of oxygen absorbed
B. According to the surface area of the body
C. According to the tables of Harris and Benedict
D. According to the formulas of Reed, Jayle, Breitman
E. According to Dreyer's formula

7. For an adult, the average value of the basal metabolic rate is normally:
A. 0.5 kcal/(kg·h)
B. 1 kcal/(kg·h)
C. 2 kcal/(kg·h)
D. 5 kcal/(kg·h)
E. 10 kcal/(kg·h)

8. By the method of indirect calorimetry, it was found that the basal metabolism of the subject was 25% higher than it should be. Disruption of which endocrine gland can be assumed?
Hypothalamus
Pituitary gland
Панечной гранПанеПационный глашениPancreas
Thyroid gland
Sex hormones

9. The release of 9.3 kcal of energy by the body corresponds to oxidation in the body:
1 g fat1 g fat
B. 1 g proteins
C. 1 g carbohydrates
D. 1 g of any substance
E. No Right Answer

10. The wear coefficient of the Rubner protein is equal to:
A. 0.014–0.028 g of nitrogen per 1 kg of body weight
B. 0.014–0.050 g of nitrogen per 1 kg of body weight
C. 0.028–0.065 g of nitrogen per 1 kg of body weight
D. 0.028–0.075 g of nitrogen per 1 kg of body weight
0.050–0.075 g of nitrogen per 1 kg of body weight

Answers: 1.C, 2.A, 3.D, 4.D, 5.C, 6.A, 7.A, 8.D, 9.A, 10.D.

Discussion of theoretical issues: in the form of answers to questions, disputes, discussions, presentations, abstracts, discussion of reports and abstracts, reviewing the answers of higher education applicants, etc.

- Sources and ways of using energy in the human body.

- Methods for determining human energy consumption. Respiratory coefficient.
- Explain what the calorimetric equivalent of oxygen is and how it changes under the oxidation of proteins, fats, and carbohydrates.
- Basic exchange and conditions for its determination. Factors influencing its magnitude.
- Working metabolism, its definition and physiological significance

Topics of reports / abstracts: when preparing a report, abstract, analytical review, etc., students can, along with this, prepare didactic visual materials in the form of tables, codegrams, slides, drawings, drug diagrams, etc. Thus, for example, "Basic and Working Exchange, Methods of Its Evaluation and Meaning. Nutritional status of a person".

Summing up.

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IW topic: Physiological characteristics of basic foods. The importance of water, animal and plant products.

Objective: to form future specialists' competencies in the field of modern physiological bases of digestion, nutrition, patterns of influence of food components on health and functions of organs and systems.

Basic concepts:

Nutritional value is a concept that reflects the entirety of the useful properties of a food product, including the degree of provision of human physiological needs in basic nutrients, energy and organoleptic properties. It is characterized by the chemical composition of the food product, taking into account its consumption in a generally accepted amount. All substances that are part of food and food are divided into two groups: organic and mineral (water, macro- and microelements). Among them are substances that determine the nutritional, including energy and biological, value, structures involved in the formation, taste, aroma and color of food products. Nutritional value is determined not only by the content of biologically active nutrients (nutrients), but also by their ratio, digestibility and good quality. The terms "energy" and "biological" value are narrower concepts of nutritional value. Energy value characterizes the proportion of energy that can be released from food in the process of biological oxidation and used to ensure the physiological functions of the body. Food is the only source of energy for humans. The amount of energy released in the process of assimilation of food by the body is called calorie content. As a result of the oxidation of one gram of fat, the body receives 37.7 kJ (9 kcal); one gram of protein 16.7 kJ (4 kcal); one gram of carbohydrates 15.7 kJ (3.75 kcal). It is the gross caloric value, that is, that which is contained in the product and released during its combustion, or the theoretical energy value. But nutrients are not fully absorbed by the body. Thus, proteins are absorbed by 94.5%, fats – by 94.0%; carbohydrates – by 95.6%. Therefore, the theoretical energy value should be multiplied by the digestibility coefficient. The digestibility coefficient of sucrose is 1, animal fats – 0.85 (except butter), vegetable fats – 0.95, proteins, depending on their nature – 0.85...0.95. Knowing the content of proteins, fats and carbohydrates in the diet and the coefficients of their digestibility, you can easily calculate the actual energy value.

Foods included in the diet should contain substances necessary for energy, metabolism and tissue building. Depending on the nature, work activity, age, sex, state of health of a person, it is necessary to consume 9218...16341 kJ (2200...3900 kcal) per day. It is important for the body which groups of nutrients provide calorie nutrition. For normal human life, a certain ratio of proteins, fats and carbohydrates is required, as well as the presence of vitamins and minerals. Proteins should make up an average of 12%, fats 30-35% of the total calorie content of the diet, the rest are carbohydrates. At present, the energy value of the generally available human diet, which corresponds to the average energy expenditure, is 8380...10,500 kJ (2,000...2,500 kcal). The composition of this diet includes mainly products that have been cooked, preserved and stored, and therefore low in vitamins and other biologically active substances. How to provide this amount of energy with the nutrients the body needs? This indicator is called the food density of the diet; It is characterized by an amount of essential nutrients of 4190 kJ (1000 kcal). The biological value of food products is determined mainly by the presence in them of essential nutritional factors that are not synthesized in the body or are synthesized in limited quantities and at low speed. The main irreplaceable components of food include 8-10 amino acids, 3-5 polyunsaturated fatty acids, all vitamins and most minerals, as well as natural physiological substances of high biological activity: phospholipids, protein-lecithin and glucoprotein complexes.

The biological value of food products is a more general concept and is characterized by the biological value of proteins, fats, carbohydrates, vitamins and minerals. The biological value of protein is characterized by the degree to which its amino acid composition corresponds to the body's needs for amino acids for protein synthesis, as well as the ability to digest. Despite the variety of protein substances in nature, 22 amino acids are involved in the construction of the human body, of which eight (leucine, isoleucine, tryptophan, valine, threonine, lysine, methionine, phenylalanine) are indispensable, since they are not synthesized in the body and must come from the outside with food. In addition, the amino acids histidine and cystine are essential for the body of infants. The indicator

of correspondence of the amino acid composition of food proteins and synthesized proteins served as the basis for the creation of a number of methods for determining and comparing the biological value of various food proteins. The amino acid composition of food products is compared with the amino acid composition of an ideal (hypothetical) protein, adopted by the FAO-WHO expert committee in 1973, by determining the amino acid score (ACC). One of the available ways to calculate AKC is to calculate the ratio of the content of essential amino acids – AKn (2.1), where m1, m2 is the amount of essential amino acids in 1 g, respectively, of the studied and ideal protein.

One gram of ideal protein contains eight AKn in the following amount, mg: isoleucine – 40; leucine – 70; lysine – 55; methionine + cystine – 35; phenylalanine + tyrosine – 60; tryptophan – 10; threonine – 40; Valine is 50 years old. In an ideal protein, the AKC of each AKn is taken as 100%. The limiting biological value of AKn is considered to be the one whose AKS value is less than 100%. Not all foods are complete in amino acid composition. Animal proteins, i.e. proteins of meat, milk, eggs, are the closest in their speed to the ideal, vegetable proteins are deficient in individual AKn, more often lysine, methionine, cystine. An imbalance in the amino acid composition of proteins can lead to metabolic disorders, a slowdown in protein synthesis and the growth of the body. An excess of some AKn leads to a lack and poor digestibility of others. Of great importance is the balance of essential AKn, a special ratio of such essential AKn as tryptophan, methionine and lysine. Their optimal ratio is 1: 2: 3.5 (4.0). Tryptophan is involved in the process of tissue repair and is found in meat, peas, beans. Methionine prevents kidney obesity, lung damage, promotes the formation of insulin; It is found in meat and grains. Lysine normalizes blood circulation, maintains the required level of hemoglobin. However, experiments on animals have shown that the calculated data of AKS do not coincide with the experimental ones, which are usually higher, and the simple correspondence of the amino acid composition of food proteins and synthesized proteins gives only an approximate idea of the biological value of proteins. Some researchers believe that the biological value of proteins is also related to the structural features of the protein components of food, which affect the solubility of the product in water, gelling formation, viscosity, moisture-holding capacity and other molecular characteristics of the product. One of the most important characteristics of nutritional value – the digestibility of food – significantly depends on the availability of protein and other biopolymer compounds to the action of enzymes. When using biological methods (on animals) to determine the biological value of proteins, the protein efficiency coefficient (KEB), the net protein utilization coefficient (CWC), the protein biological value index (PBC), the nitrogen retention coefficient (CRA) and others are calculated. The biological value of fats is determined by the polyunsaturated fatty acids (PUFAs) that are part of them and which are also called vitamin F. PUFAs are essential nutritional factors, since they are not formed in the body and must be supplied with food. Together with the energy function, PUFAs help to accelerate cholesterol metabolism in the body, reduce the formation of low-density lipoproteins responsible for atherosclerosis, and reduce the synthesis of triglycerides. For humans, the essential fatty acids are linoleic C18:2, linolenic C18:3. Linoleic acid is converted in the body to arachidonic acid C22:4, and linolenic acid to eicosapentaenoic acid. Insufficient intake of linoleic acid with food causes a violation of the biosynthesis of arachidonic acid in the body, which is included in large quantities in its structural lipids, as well as prostaglandins. Arachidonic acid makes up 20-25% of all fatty acids, phospholipids, cellular and subcellular biomembranes. PUFAs formed from linolenic acid (eicosapentaenoic acid and docosahexaenoic acid) are also constantly present in membrane lipids, but in much smaller quantities (2...5%) than arachidonic acid. It is important to emphasize that the methods for determining the biological value of fats are integral, since they do not reveal the effects of each of the acids on lipid metabolism. Unlike proteins, it is not currently possible to determine the biological value of fats on the basis of their chemical composition. To assess the biological effect of various fats on the human body, the concept of the coefficient of efficiency of fatty acid metabolism (CEM) has been introduced. It characterizes the ratio of the amount of arachidonic acid to the sum of all other polyunsaturated acids with 20 and 22 carbon atoms. It is important to note that CEM increases in parallel with a decrease in arachidonic acid. The prospect of the possible use of CEM as a diagnostic test to detect lipid metabolism disorders in humans is very real and valuable. Recent scientific achievements, which more deeply reveal the functions of fats in

the human body, have led to changes in the norms of their consumption with food. Thus, in comparison with the previous recommendations, there is a tendency to increase fat intake with unchanged or even reduced carbohydrate intake. The quantitative and qualitative characteristics of fats are of great importance. The latter significantly depends on the technology of their production and storage. The biological value of carbohydrates is determined by the quantitative composition of digestible and non-digestible carbohydrates. An important role is given to digestible carbohydrates that normalize metabolic processes in the body. In recent years, much attention has been paid to dietary fiber – ballast substances belonging to the group of indigestible carbohydrates (pectin, fiber, hemicellulose). The biological value of vitamins is determined by their participation in cellular and tissue metabolism, a significant effect on the functional state of many physiological systems, on the reactivity of the body and its defense mechanisms. The biological value of minerals is determined by their absolute content and ratio to each other in products and their specific effect on metabolic processes.

Equipment: textbooks, manuals, guidelines on the topic of the seminar, multimedia projector, laptop, interactive whiteboard.

Plan:

Organizational measures:

- Greeting
- checking attendees,
- communication of the topic, purpose of the lesson,
- motivation of higher education students to study the topic.

Control of the basic level of knowledge:

- Written work
- written testing,
- Frontal survey on basic terminology
-

Questions (situational tasks) to test basic knowledge on the topic of the seminar:

Situational task 1. Two subjects are offered a physiological competition. For a certain amount of time, they will both breathe at the same frequency and depth. One determines the total amount of air he inhaled, the other the amount of air he exhaled. The winner is the one whose indicator is higher. Which option would you choose for yourself if you participated in such a competition? Explain why. In which case would the competition always end in a draw?

Answer: Under normal conditions, the amount of CO_2 emitted is always less than the amount of O_2 absorbed, i.e. the DC value is less than 1. Therefore, to win, you need to choose the air you breathe. And it would be a draw if it was possible to create such an artificial situation when only carbohydrates would be oxidized in the body and the DC would be equal to one.

Situational task 2. Calculate the amount of energy released if only carbohydrates were oxidized during the experiment, and 6 liters of CO_2 were released.

Answer: If carbohydrates were oxidized, then the DC is 1. Therefore, the amount of absorbed O_2 is also 6 liters. The caloric equivalent of O_2 under DC conditions equal to 1 is 5.05 kcal. Multiplying this value by 6, we get 30.3 kcal.

Situational task 3: Ice calorimeters were used in early calorimetric experiments. Such a device was a double-walled chamber, the space between the walls of which was filled with ice. An experimental animal was placed in the chamber. Depending on the amount of heat released, a certain fraction of ice melted, which was taken into account during further calculations. There are such materials: copper, iron, nickel, glass, sawdust, granite. Explain what material you will offer for the manufacture of external and internal walls of the calorimeter.

Answer: The inner walls need to conduct heat very well in order to transfer heat quickly to the ice. The outer walls, on the other hand, should be as thermally conductive as possible in order to insulate the ice from the outside temperature. Thus, there is copper for the inner walls, and sawdust between

the glass for the outer walls.

Discussion of theoretical issues: in the form of answers to questions, disputes, discussions, presentations, abstracts, discussion of reports and abstracts, reviewing the answers of higher education applicants, etc.

- Sources and ways of using energy in the human body.
- Methods for determining human energy consumption. Respiratory coefficient.
- Explain what the calorimetric equivalent of oxygen is and how it changes under the oxidation of proteins, fats, and carbohydrates.
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- Working metabolism, its definition and physiological significance

Topics of reports / abstracts: when preparing a report, abstract, analytical review, etc., students can, along with this, prepare didactic visual materials in the form of tables, codegrams, slides, drawings, drug diagrams, etc. Thus, for example, "Basic and Working Exchange, Methods of Its Evaluation and Meaning. Nutritional status of a person".

Summing up.

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- Testing Center – Krok-1 Licensed Test Items Database https://www.testcentr.org.ua/uk/
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- V.I. Vernadsky National Library of Ukraine http://www.nbuv.gov.ua/
- Ministry of Health of Ukraine: official website. URL: https://moz.gov.ua/.
- National Health Service of Ukraine: official website. URL: https://nszu.gov.ua/pro-nszu
- National Academy of Medical Sciences of Ukraine. URL: www.amnu.gov.ua.
- European Health for All Database. URL: http://medstat.gov.ua/ukr/statreports.html.

IW topic: Physiological features of protein metabolism.

Objective: to form future specialists' competencies in the field of modern physiological bases of digestion, nutrition, patterns of influence of food components on health and functions of organs and systems.

Basic concepts:

Protein metabolism

Functions of proteins in the body:

1. Structural basis of all cells and subcellular structures (plastic function). 2. They are transmitters of hereditary information (nucleoproteins, which include DNA and RNA). 3. Chemical processes are accelerated by proteins-enzymes. 4. Regulate vital processes — proteins-hormones. 5. Create oncotic pressure — participation in water exchange. 6. Participate in immunity (immunoglobulins). 7. Energy role: 1.0 g protein + O2 -> 4.1 kcal (17.18 kJ). 8. Specific functions that underlie the differentiation of individual physiological systems (functional proteins).

Types of protein synthesis

According to the functional value, the following types of protein synthesis are distinguished:

1. Synthesis of growth is an increase in the protein mass of organs during the period of growth and differentiation of the organism as a whole. Quantitative indicators of growth are weight gain and the level of positive nitrogen balance. 2. Synthesis of specific proteins is the basis of cell and tissue differentiation and is the synthesis of specific enzymatic structural and functional proteins. For example, the synthesis of enzymatic systems that ensure the formation of the end products of protein metabolism of uric acid — urea; formation of coagulation and anticoagulation systems. 3. Synthesis of functional proteins — the formation of proteins "for excretion" for other organs and systems (plasma proteins, protein enzymes of the glands of the digestive system, protein hormones of some endocrine glands). 4. Synthesis of regeneration (excited) occurs for the regeneration of damaged tissues or in case of malnutrition. 5. The synthesis of self-renewal associated with the stabilization of the organism is the constant replenishment of cytoplasmic components that are destroyed during dissimilation.

The need for protein at different ages

The physiological need for proteins is a multicomponent concept. First of all, it is determined by the amount of protein that goes to support life and compensate for the inevitable loss of protein. This value is stable and amounts to 0.9 g/kg of body weight in a young child. In addition, the need for protein implies the amount of protein that is necessary for the synthesis of new cells. On average, the protein required to gain 1g of body weight requires 0.05 g/kg of body weight.

When taking into account the average daily weight gain, this additional value of protein requirement for children of the first 3 months of life is on average 1.5 g/kg of body weight, and at the age of 11–12 months — 0.2–0.5 g/kg of body weight. An additional amount of protein has been established: it is necessary to add 0.9 g/kg of body weight to the weight gain, which in total is the main amount of it that is necessary for a child of the 1st year of life to ensure the main physiological processes. Ratio with fats and carbohydrates 1:1:4

At any age, the need for protein consists of:

1. The minimum requirement, which provides only endogenous protein consumption. 2. Physiological need, in addition to endogenous costs, which includes the amount of protein necessary for growth. 3. Average physiological need, taking into account the "reserve" coefficient, which is equal to 1.3.

There is also an "optimal protein requirement" (protein optimum), which includes the average physiological requirement, taking into account the margin correction factor.

All forms of synthesis are related to each other and weaken with age, albeit unevenly.

The synthesis of growth undergoes the greatest changes: in its progressive form, it develops more intensively, gradually weakening at the time of the cessation of growth.

By old age, the synthesis of regeneration and self-healing is weakened. This is manifested in a deterioration in wound healing, in an increase in healing time and in the appearance of external signs of skin age, for example, in connection with a weakening of the synthesis of self-healing, which maintains a decrease in the level of biochemical homeostasis in old age until the last days of life.

During the periods of early and first childhood, there is a slow decline in growth. The 2nd childhood and adolescence are characterized by a slight increase in growth rates. K_w rises to 1.0–1.5. By the age of 18, growth practically stops, and K_w drops to a value of 0.48.

In the late XIX–early XX centuries. Growth ended at the age of 23-25. In the second half of the XX century. Due to the acceleration that developed in the middle of the 20th century, the progressive

phase of growth ended by the age of 17-18, that is, 5-6 years earlier, so there is an acceleration of physical development. The rate of formation of physiological systems, such as the cardiovascular system, is accelerating. Therefore, there is a need to develop medical hygienic and educational measures that would contribute to the synchronization of the processes of somatic and functional development.

Functional and excited synthesis

Intensive synthesis of specific proteins is associated with the differentiation of organs and tissues and attenuates already in the early stages of postnatal life, while the synthesis of functional proteins persists throughout life and weakens until old age.

Excited synthesis also decreases in old age, but to a lesser extent. One of the types of excited synthesis is **the induced synthesis** of enzymes of carbohydrate and protein metabolism under certain conditions, for example, when enzymes adapt to certain dietary regimes.

Synthesis of Self-Healing

In periods of stable and regressive development, when growth stops and maximum weight is reached (according to age), the main role is played by self-healing processes, they fade away to old age, but to a lesser extent than other types of synthesis. The intensity of self-healing can be evidenced by the wear coefficient, which is the maximum amount of nitrogen excreted in the urine during a protein-free diet ("endogenous" urine nitrogen).

With age, the amount of "endogenous" urine nitrogen in humans decreases. Its level per 1 kg of body weight varies widely in different age groups.

Features of protein metabolism and its regulation at different ages

Prenatal period

This period is characterized by intensive synthesis of growth and functional synthesis.

Regulation of protein synthesis is carried out by hormones: 1) thyroid gland; 2) pancreas; 3) chorionic somatotropin.Somatotropin of the pituitary gland is secreted little, most of it is synthesized in the last trimester of pregnancy, but the receptors for somatotropin in the cells have not yet matured. There is an intensive growth of the skeleton, muscle mass due to the synthesis of growth and functional synthesis, a fairly highly developed synthesis of excited (restored) and synthesis of recovery. By the age of 2-3 years, their activity increases. In older children, the activity of proteinases increases 10 times compared to infants.Protein in the blood plasma of full-term infants is 60 g/l, in adults — 70–80 g/l. Only by the age of 5, the synthesis of immunoglobulins almost reaches the intensity of an adult.The insufficiency of immunoglobulins in the blood of 5-year-old children is explained by a high susceptibility to diseases. An indicator of interstitial protein metabolism is the distribution of nitrogen in the urine. In children, it is different compared to adults: in infants, ammonia is converted into uric acid, so there is more uric acid than urea. In adults, ammonia passes mainly into urea, so there is more of it than uric acid. In children, more amino acids are excreted in the urine than in adults. Thus, in infants (up to 1 year of age), amino acids make up about 10% of the total urine composition, while in adults — 3-4%. A feature of the protein metabolism of children is the presence of creatine in the urine along with creatinine.

Regulation of protein metabolism in the postnatal period

The **perinatal period** is characterized by the predominance of catabolism processes over anabolism processes, as a result, the child loses weight. During this period, a lot of glucocorticoids are released.

In infants and young children, somatotropic hormone (GH) plays a significant role in ensuring the intensive growth of the skeleton, muscle mass and all organs, which:

1. Stimulates the proliferation of chondriocytes of epiphyseal cartilage. 2. Increases the permeability of cell membranes to amino acids. 3. Stimulates RNA synthesis. 4. Increases the incorporation of amino acids into the protein of bone tissue, muscles, liver, kidneys. 5. Inhibits the activity of proteolytic enzymes (proteins). 6. Stimulates growth factors in organs (nerves, kidneys, etc.). 7. It mediates its action through somatomedin, which it synthesizes in tissues.

The result of the effect of GH is an anabolic effect and a positive nitrogen balance. To ensure the anabolic effects of GH, the participation of insulin is required.

Insulin, in turn: 1. Increases the transport of amino acids across cell membranes, especially in muscle cells. 2. Stimulates the release of somatotropic hormone by lowering blood sugar. With insulin deficiency in childhood, the child's growth is inhibited.

Sex hormones Testosterone enhances protein synthesis in the liver, kidneys, skeletal and cardiac muscles.

Estrogens provide anabolism only in relation to the genitals.

Thyroxine, triiodothyrosine. 1. With hyperthyroidism, there is a negative nitrogen balance and growth retardation. 2. With hypothyroidism — growth retardation. 3. With a low content in the blood, protein synthesis enzymes are activated. 4. At normal content, the synthesis of proteins and amino acids is reduced.

Glucocorticoids provide a catabolic effect: 1. Cause the breakdown of proteins in lymphoid and connective tissues. 2. Use released amino acids to form carbohydrates (gluconeogenesis).

After birth at high growth rates:

1. The bulk of amino acids are used not only for the synthesis of proteins, but also for the synthesis of nucleic acid synthesis precursors. 2. Low activity of catabolic enzymes.In early childhood, protein metabolism prevails over other types of metabolism. In this process, GH and insulin, thyroidin, testosterone play an important role. During the transition to adolescence, the growth of tubular bones decreases because the synthesis of GH decreases. During this period, GH regulates not growth, but the formation of new proteins, the processes of synthesis of self-healing and stimulates growth factors in tissues with the development of organ hypertrophy. In old people, the activity of catabolic enzymes increases, so their wear coefficient is higher than in previous age periods. In the process of aging, the most profound age-related changes are inherent in the synthesis of growth, the intensity of which decreases. Restorative synthesis is also decreasing. Pronounced age-related changes in functional synthesis and synthesis of self-healing are weakened. Thus, there was little change in protein recovery in people aged 67–91 compared to 18–25 years of age. In the human liver, about 25.0 g of new protein is formed daily, in the blood plasma about 8.0 g is replaced per day. Under normal conditions, up to 400.0 g of new protein is synthesized daily in the body of an adult and the same amount is broken down. The rate of protein recovery is evidenced by the fact that half of the protein composition of the liver is restored within 5-7 days. A high rate of protein recovery is also high in the brain and skin.

In old age:

1. The rate of protein synthesis decreases. 2. The synthesis of serum albumin in the liver increases after a previous decrease in its intensity during maturity. 3. The half-life of proteins increases. 4. The properties of proteins change: protein enzymes contain molecules that have completely lost their activity; there are disorders of the molecular structure in the process of protein synthesis; the structure of the molecule changes after protein synthesis in the process of functioning; Recovery processes are slowed down. 5. The proteolytic activity of proteins decreases. 6. The body acquires the ability to remove excess amino acids that were not utilized during protein synthesis, or used to form carbohydrates, fats, etc. energy substances. 7. The utilization of ammonia for the synthesis of glutamine is reduced.

Assessing the decrease in proteolytic activity in old age, coupled with a weakening of the synthesis of individual proteins, it can be assumed that this can contribute to maintaining a certain level of protein concentration in the cell. An increase in the activity of some tissue proteolysis enzymes in old age can be considered as an adaptation of the body aimed at destroying proteins with an altered structure, and thus preventing their accumulation in old age. Finally, an increase in the activity of specific proteins and, under their influence, an accelerated breakdown of certain proteins, which lead to a decrease in their concentration in the cell, can be one of the mechanisms for the implementation of a genetically determined weakening of the functions and vital functions of the body in general in old age.

Changes in individual links of protein metabolism in old age can adversely affect the functions of individual organs and systems.

Nitrogen balance. An indicator of the level of protein metabolism is the nitrogen balance. The progressive phase of development is accompanied by intensive protein metabolism. The younger the

organism, the greater the magnitude of the positive balance and the better the ability to retain the protein nitrogen of the food. With age, the need for essential amino acids changes: by the age of 1 year, the need for them increases, in adolescents and adults they decrease several times.

With the cessation of growth, a nitrogenous equilibrium is established, which can be disturbed in one direction or another under certain conditions. Thus, a positive nitrogen balance develops during the period of muscle building in athletes, after partial or complete starvation in the recovery period, during the recovery period after serious illnesses, after hard exhausting work. A shift towards a negative nitrogen balance is observed during starvation, complete or protein, severe illness, during hard exhausting work. In the process of aging, elderly and senile people develop a negative nitrogen balance due to a weakening of synthesis and an increase in the wear coefficient.

Equipment: textbooks, manuals, guidelines on the topic of the seminar, multimedia projector, laptop, interactive whiteboard.

Plan:

Organizational measures:

- Greeting
- checking attendees,
- communication of the topic, purpose of the lesson,
- motivation of higher education students to study the topic.

Control of the basic level of knowledge:

- Written work
- written testing,
- Frontal survey on basic terminology

Questions (test tasks) to test basic knowledge on the topic of the seminar:

1. Which hormone stimulates protein synthesis in the liver?
Aldosterone
Calcitonin
C. Кортизол
Somatotropic hormoneSomatotropic hormone
Testosterone

2. Which hormone stimulates fat synthesis?
Adrenaline
B. Thyroxine
Glucocorticoids
D. Glucagon
Insulin

3. Somatotropic hormone of the adenohypophysis carries out:
Anabolic effect on the metabolism of fats and proteinsAnabolic effect on the metabolism of fats and proteins
Catabolic effect on the metabolism of fats and proteinsCatabolic effect on the metabolism of fats and proteins
C. Anabolic effect on fat metabolism and catabolic effect on carbohydrate metabolism
Catabolic effect on carbohydrate metabolism and anabolic effect on protein metabolism
Anabolic effect on protein metabolism and catabolic — on fat metabolism

4. Patient S., 36 years old, complained of obesity and increased swelling against the background of a strict diet. Objectively detected: hyperglycemia, hypernatremia, hyperstenuria. What endogenous disorders can be assumed?
Hypofunction of the thyroid gland
Hyperfunction of the adrenal cortexHyperfunction of the adrenal cortex
Hyperfunction of the ovaries
Hypofunction of the thyroid glandHypofunction of the thyroid gland
Hypofunction of the parathyroid glandsHypofunction of the parathyroid glands

5. A derivative of carbohydrate metabolism that is not synthesized in the body:
Фолий aFolic acid
Ascorbic acid
Cyanocobalamin
Biotin
Riboxin

6. Central glucoreceptors are located in:
Anterior hypothalamusAnterior hypothalamus
Posterior hypothalamus
C. Mosti
Cerebellum
Cori of large hemispheres

7. Promotes Glucose Utilization by Cells:
A. Glucagon
B. Adrenaline
Insulin
Thyroxine
Somatotropic hormoneSomatotropic hormone

8. A decrease in the concentration of glucose in the blood leads to an increase in secretion:
Acetylcholine
Histamine

Adrenaline
Serotonin
Dopamine

9. A person was admitted to the emergency department with complaints of heart palpitations, weakness and tremor of muscles, dizziness, increased sweating. From the anamnesis, it is known that for 10 years he has been suffering from diabetes mellitus, regularly takes hypoglycemic drugs. The person was injected:
Insulin
Solution of glucoseSolution of glucose
Sodium chloride
Magnesium sulfateMagnesium sulfate
E. Calcium chloride

10. Derivatives of carbohydrate metabolism that are synthesized in the body, except:
Фольической ошикий оFolic acid
Ascorbic acid
Cyanocobalamin
Biotin
Riboxin

Answers: 1.D, 2.E, 3.A, 4.B, 5.A, 6.A, 7.C, 8.C, 9.B, 10.A.

Discussion of theoretical issues: in the form of answers to questions, disputes, discussions, presentations, abstracts, discussion of reports and abstracts, reviewing the answers of higher education applicants, etc.

Protein metabolism is the use and conversion of amino acids in proteins in the human body. When 1 g of protein is oxidized, 17.6 kJ (4.1 kcal) of energy is released.However, the body rarely uses large amounts of proteins to cover its energy expenditure, since proteins are needed to perform other functions (the main function is **construction**). The human body does not need food proteins per se, but the amino acids of which they are composed. amino acids are absorbed in the small intestine into the bloodstream and carried to the cells, in which the synthesis of new own proteins inherent in humans occurs.

The level of amino acids in the blood is regulated **by the liver**. As amino acids break down, they form water, carbon dioxide, and poisonous ammonia. In liver cells, urea is synthesized from the formed ammonia (which is then excreted along with water by the kidneys in the urine and partially by the skin), and carbon dioxide is exhaled through the lungs.

Amino acid residues are used as an energy material (converted into glucose, the excess of which is converted into glycogen).

Topics of reports / abstracts: when preparing a report, abstract, analytical review, etc., students can, along with this, prepare didactic visual materials in the form of tables, codegrams, slides, drawings, drug diagrams, etc. For example, "The physiological role of proteins and the peculiarities of their metabolism".

Summing up.

Recommended Reading List:

Main:
1. Costanzo L. S. Physiology / L. S. Costanzo. - Elsevier Health Sciences. - 7th ed., 2021. - 528 p.
2. Ganong's Review of Medical Physiology / K. E. Barrett, S. M. Barman, H. L. Brooks., J. Yuan, - McGraw Hill Medical. – 26th edition, 2019. –752 p.
3. Guyton A. Textbook of Medical Physiology / A. Guyton, J. E. Hall. - Elsevier. - 14th Edition, 2021. – 1820 p.

Additional
4. Koeppen B. M. Berne and Levy Physiology / B. M. Koeppen, B. A. Stanton. - Elsevier Health Sciences. - 8th edition, 2023. – 864 p.
5. Sembulingam K. Essentials of Medical Physiology / K. Sembulingam, P. Sembulingam. – Jaypee Brothers Medical Publishers. – 9th ed., 2022. –1022 p.*Electronic Information Resources*

- Official website of the Department of Physiology of ONMedU https://info.odmu.edu.ua/chair/physiology/files
- Testing Center – Krok-1 Licensed Test Items Database https://www.testcentr.org.ua/uk/
- National Scientific Medical Library of Ukraine http://library.gov.ua/
- V.I. Vernadsky National Library of Ukraine http://www.nbuv.gov.ua/
- Ministry of Health of Ukraine: official website. URL: https://moz.gov.ua/.
- National Health Service of Ukraine: official website. URL: https://nszu.gov.ua/pro-nszu
- National Academy of Medical Sciences of Ukraine. URL: www.amnu.gov.ua.
- European Health for All Database. URL: http://medstat.gov.ua/ukr/statreports.html.

IW topic: Physiological features of carbohydrate metabolism.

Objective: to form future specialists' competencies in the field of modern physiological bases of digestion, nutrition, patterns of influence of food components on health and functions of organs and systems.

Basic concepts:

Functions of carbohydrates:

1. Energy source: 1.0 g carbohydrates + O2 = 4.1 kcal (17.18 kJ). For the brain, it is the only source of energy necessary for brain respiration, the synthesis of macroergic compounds and mediators, in the prenatal period it is the only source of energy.2. It is a reserve of energy substances (liver glycogen) in case of long-term non-intake of food into the body.3. Plastic function: carbohydrates form compounds with proteins in the form of mucopolysaccharides, glycoproteins, etc., and are part of the cytoplasm, cell membranes, subcellular structures, nucleic acids, enzymes.4. Support function - carbohydrates are involved in the formation of the main substance of bones, cartilage, connective tissue.5. They participate in the processes of osmosis (glucose in the composition of body fluids), that is, they participate in the regulation of water metabolism, binding water.6. Protective function: a) carbohydrates are necessary for the neutralization of toxic chemicals in the liver (formation of glucuronic acid); b) are part of antibodies and therefore participate in the body's immune defense.7. Carbohydrates are involved in maintaining acid-base balance, as they contribute to the combustion of acidic products of protein and fat metabolism into carbon dioxide and water.8. Glucose can be a source of synthesis of non-carbohydrates (proteins, fats).

Stages of carbohydrate metabolism: glycogenesis; glycogenolysis (glycolysis); gluconeogenesis (in children it is limited, because the intensive growth of the child's body requires more plastic material — proteins and fats).

All three processes are interdependent and aimed at maintaining the stability of blood sugar levels. The human liver releases an average of 3.5 mg of glucose per 1 kg of body weight per minute per 1 m2 of body surface into the blood.

Carbohydrate needs at different ages

Carbohydrate metabolism in a child's body is characterized by: 1. Much higher intensity than carbohydrate metabolism in an adult's body. 2. High digestibility of carbohydrates (98-99%), regardless of the method of feeding. With an excess of carbohydrates in food, glucose is excreted in the urine. Children are more resistant to high blood sugar than adults. In adults, glucose appears in the urine if it is ingested with food 2.5–3.0 g per 1 kg of body weight; In children, this occurs only with an intake of 8.0–12.0 g/kg of body weight. In the child's body, the formation of carbohydrates from proteins and fats (glyconeogenesis) is weakened, since growth requires increased consumption of protein and fat reserves of the body. Carbohydrates in the body of a child are deposited in much smaller quantities than in the body of an adult. Young children are characterized by a rapid depletion of liver carbohydrate reserves. The daily need for carbohydrates in children is high and amounts to 10-12 g per 1 kg of body weight per day in infancy, due to which about 40% of the total caloric requirement of the child should be provided. In subsequent years, the amount of carbohydrates, depending on the constitutional characteristics of the child, ranges from 8-9 to 12-15 g per 1 kg of

body weight per day. During this period, carbohydrates provide 50-60% of the total caloric requirement. In the first half of life, the child receives the necessary amount of carbohydrates in the form of disaccharides. From 6 months, there is a need for polysaccharides. The daily amount of carbohydrates that children should receive with food increases significantly with age: from 1 to 3 years - 193 g, from 4 to 7 years - 287.9 g; from 8 to 13 years old - 370 g; from 14 to 17 years old — 470 g, which is almost equal to the norm of an adult (500 g according to the Institute of Nutrition of the Academy of Medical Sciences of the USSR). The peculiarity of the organism of children and adolescents is a less perfect carbohydrate metabolism in terms of the ability to quickly mobilize the internal carbohydrate resources of the body and, especially, to maintain the necessary intensity of carbohydrate metabolism when performing physical work. Thus, in children and adolescents, when performing physical exercises, there is a decrease in their blood, while in adults, performing the same exercises leads to an increase in blood sugar levels. At the age of 3-4 months of life, with the time of functional maturation of the mucous membrane of the alimentary canal, along with mono- and disaccharides in the diet of children, a certain proportion should be occupied by foods rich in polysaccharides - starch, fiber. An important source of starch and fiber, starting from 4-5 months of life, are vegetables and cereal dishes, and from 8-9 months also crackers and cookies. The coarse fiber requirement for children 2–5 years old is 3.0–4.0 g/day, for schoolchildren — 4.1–6.7 g/day. A more intensive carbohydrate metabolism in a child compared to adults is associated with an increase in energy needs. The formation of carbohydrates from proteins and fats in children is weakened. The younger the child, the more intense his glycolytic processes are and the more lactic acid is contained in the blood. In spring, when growth processes are enhanced, the amount of lactic acid in the blood is higher than in winter. After the age of 50, carbohydrate tolerance decreases, and the curves of alimentary hyperglycemia often become diabetic in nature.

Regulation of carbohydrate metabolism. The leading role in the reception of blood glucose belongs to the lateral and ventromedial nuclei of the hypothalamus. Their cells have a selective sensitivity to changes in blood glucose levels. The chemoreceptors of blood vessels and tissues are also sensitive to changes in blood glucose. Excitation of the hypothalamic nuclei leads to excitation of the sympathetic nervous system, increased secretion of catecholamines, increased production of glucagon, activated synthesis of hypothalamic liberins, secretion of ACTH, somatotropin by the pituitary gland and glucocorticoids by the adrenal glands. The secretion of catecholamines is stimulated by hypoglycemia. Catecholamines (adrenaline, norepinephrine, dopamine) circulate in the blood in connection with protein. Free catecholamines are quickly destroyed by enzymes. Excitation of □-adrenergic receptors causes activation of adenylate cyclase and synthesis of cAMP (secondary mediator), which triggers intracellular metabolism. Excitation of □-adrenergic receptors causes a decrease in cAMP concentrations in target cells; the calcium-dependent ATPase is activated, which regulates the transport of Ca^{++} across the membrane (secondary intermediary). For blood glucose regulation, adrenaline is more important compared to other catecholamines.

Effects of hormones

1. Adrenaline – causes glycogenolysis in the liver and muscles. 2. Norepinephrine and the sympathetic nervous system perform a similar action, but weaker. 3. Glucagon — its secretion is stimulated by: gastrin; cholecystokinin-pankeosimin; sympathetic nervous system Its secretions are inhibited: secretin; pancreatic somatostatin. In the action of glucagon, two phases are distinguished: glycogenolysis only in the liver; glucagon exerts its action through cAMP — gluconeogenesis 4. ACTH — glucocorticoids (cortisol): enhances the breakdown of protein in tissues other than the liver; provides gluconeogenesis from amino acids and fatty acids; increases the glycogen content of the liver due to gluconeogenesis. 5. Somatotropin (GH) — its production is stimulated by hypoglycemia. For the anabolic effect of GH, the participation of insulin is required.6. Insulin – free insulin acts on muscles, adipose tissue, liver and brain; bound to proteins — to adipose tissue. Hormones with a hyperglycemic effect (GH, ACTH, glucocorticoids), secretin, intestinal glucagon, gastrin enhance insulin secretion. Insulin has the following properties: it lowers blood glucose, because it increases the permeability of cell membranes to glucose; activates glucokinase in the liver, which enhances carbohydrate metabolism; enhances glucogenesis in the liver, which increases the content of glucogen

in the liver; inhibits glycogenolysis in the liver; inhibits gluconeogenesis; promotes the conversion of carbohydrates into fats.

Age-related features of carbohydrate metabolism are due to a number of factors: 1. The production of insulin and glucagon undergoes age-related dynamics. In childhood and young adulthood, the pancreas is dominated by large islets of insulin-producing cells. In old age, many small islets are found that hold glucagon-producing cells. Consequently, insulin secretion predominates in childhood and young adulthood, and glucagon secretion predominates in old age. 2. Carbohydrate metabolism is carried out in different ways: the fetus has an anaerobic pathway of carbohydrate breakdown, because there is not enough oxygen for oxidative processes. Glycogen synthesis in the liver is enhanced in the last trimester of pregnancy; in a child of 1 month of the postnatal period, aerobic and anaerobic pathways of carbohydrate breakdown are of the same intensity, intensive glycolysis occurs with the formation of lactic acid; In infancy and later, gluconeogenesis begins to act and there is no need to use glucose reserves. Needs are also provided by gluconeogenesis; in adolescents, the synthesis of somatotropin is activated, which stimulates the synthesis of insulin; The onset of depletion of the insular apparatus is possible, in this case, hyperglycemia develops, diabetes mellitus may develop. 3. Educational and muscular load, emotional stress affect carbohydrate metabolism and its endocrine regulation. In schoolchildren, long breaks in eating cause hypoglycemia, which leads to a deterioration in school performance and emotional status. Schoolchildren with a high initial glucose level (at the level of the upper limit of normal) develop hypoglycemia after classes, the glucose content drops to the lower limit. In schoolchildren with a low glucose content at the level of the lower limit of normal, the blood glucose content rises (even above normal) after classes. During muscle loads, hypoglycemia occurs more easily in children than in adults, because the newly created glucose does not keep up with its consumption, due to the fact that the power of gluconeogenesis enzymes is still low.

In the process of aging, carbohydrate metabolism gradually undergoes changes: the activity of synthetic and glycolytic (especially glycolytic) enzymes is disturbed; the glucogen-deposition function of the liver decreases; glycogen stores in the myocardium decrease; the permeability of cell membranes decreases; the mechanisms of glucose oxidation are weakened; gluconeogenesis is enhanced and the liver's great potential for gluconeogenesis is preserved; the pathways of glucose conversion change, due to the fact that in old age the synthesis of proteins is inhibited, there is a restriction on the utilization of amino acids in the synthesis of other substances; increases carbohydrate catabolism and reduces the use of glucose by cells; The formation of lactate, which is utilized in the process of gluconeogenesis, increases.

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2. Which hormone stimulates fat synthesis?
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6. Central glucoreceptors are located in:
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Posterior hypothalamus
C. Mosti
Cerebellum
Cori of large hemispheres

7. Promotes Glucose Utilization by Cells:
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B. Adrenaline
Insulin
Thyroxine
Somatotropic hormoneSomatotropic hormone

8. A decrease in the concentration of glucose in the blood leads to an increase in secretion:
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Histamine
Adrenaline
Serotonin
Dopamine

9. A person was admitted to the emergency department with complaints of heart palpitations, weakness and tremor of muscles, dizziness, increased sweating. From the anamnesis, it is known that for 10 years he has been suffering from diabetes mellitus, regularly takes hypoglycemic drugs. The person was injected:
Insulin
Solution of glucoseSolution of glucose
Sodium chloride
Magnesium sulfateMagnesium sulfate
E. Calcium chloride

10. Derivatives of carbohydrate metabolism that are synthesized in the body, except:
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Biotin
Riboxin

Answers: 1.D, 2.E, 3.A, 4.B, 5.A, 6.A, 7.C, 8.C, 9.B, 10.A.

Discussion of theoretical issues: in the form of answers to questions, disputes, discussions, presentations, abstracts, discussion of reports and abstracts, reviewing the answers of higher education applicants, etc.

Carbohydrate metabolism is a set of processes for the conversion and use of carbohydrates. Carbohydrates are the main **source of energy** in the body. When 1 g of carbohydrates (glucose) is oxidized, 17.6 kJ (4.1 kcal) of energy is released. Carbohydrates enter the human body in the form of various compounds: starch, glycogen, sucrose or fructose, etc. All these substances break down during digestion into the simple saccharide **glucose**, are absorbed by the villi of the small intestine and enter the bloodstream.

Glucose is essential for normal brain function. A decrease in plasma glucose from 0.1 to 0.05% leads to rapid loss of consciousness, convulsions and death. Most of the glucose is oxidized in the body to carbon dioxide and water, which are excreted from the body through the kidneys (water) and lungs (carbon dioxide). Part of the glucose is converted into the polysaccharide glycogen and stored in the liver (up to 300 g of glycogen can be stored) and muscles (glycogen is the main supplier of

energy for muscle contraction). Blood glucose levels are constant (0.10 to 0.15%) and are regulated by thyroid hormones, including **insulin**. With a lack of insulin, the level of glucose in the blood rises, which leads to a serious disease - diabetes mellitus. Insulin also inhibits the breakdown of glycogen and helps increase its content in the liver.

Another pancreatic hormone, **glucagon,** promotes the conversion of glycogen into glucose, thereby increasing its content in the blood (i.e., it has the opposite effect of insulin).

With a large amount of carbohydrates in food, their excess is converted into fats and deposited in the human body. 1 g of carbohydrates contains significantly less energy than 1 g of fat. However, carbohydrates can be quickly oxidized and energy can be obtained quickly.

Topics of reports / abstracts: when preparing a report, abstract, analytical review, etc., students can, along with this, prepare didactic visual materials in the form of tables, codegrams, slides, drawings, drug diagrams, etc. For example, "The physiological role of carbohydrates and the features of their metabolism".

Summing up.

Recommended Reading List:

Main:

1. Costanzo L. S. Physiology / L. S. Costanzo. - Elsevier Health Sciences. - 7th ed., 2021. - 528 p.

2. Ganong's Review of Medical Physiology / K. E. Barrett, S. M. Barman, H. L. Brooks., J. Yuan, - McGraw Hill Medical. – 26th edition, 2019. –752 p.

3. Guyton A. Textbook of Medical Physiology / A. Guyton, J. E. Hall. - Elsevier. - 14th Edition, 2021. – 1820 p.

Additional

4. Koeppen B. M. Berne and Levy Physiology / B. M. Koeppen, B. A. Stanton. - Elsevier Health Sciences. - 8th edition, 2023. – 864 p.

5. Sembulingam K. Essentials of Medical Physiology / K. Sembulingam, P. Sembulingam. – Jaypee Brothers Medical Publishers. – 9th ed., 2022. –1022 p.

Electronic Information Resources

- Official website of the Department of Physiology of ONMedU https://info.odmu.edu.ua/chair/physiology/files
- Testing Center – Krok-1 Licensed Test Items Database https://www.testcentr.org.ua/uk/
- National Scientific Medical Library of Ukraine http://library.gov.ua/
- V.I. Vernadsky National Library of Ukraine http://www.nbuv.gov.ua/
- Ministry of Health of Ukraine: official website. URL: https://moz.gov.ua/.
- National Health Service of Ukraine: official website. URL: https://nszu.gov.ua/pro-nszu
- National Academy of Medical Sciences of Ukraine. URL: www.amnu.gov.ua.
- European Health for All Database. URL: http://medstat.gov.ua/ukr/statreports.html.

IW topic: Physiological features of lipid metabolism.

Objective: to form future specialists' competencies in the field of modern physiological bases of digestion, nutrition, patterns of influence of food components on health and functions of organs and systems.

Basic concepts:

Lipid metabolism. Functions of lipids in the body:

1. It is a source of energy: 1.0 g fat + O2 -> 9.3 kcal (38.9718 kJ). 2. They perform a plastic function, as they are part of the structural components of the body's cells. 3. They are precursors of some hormones (glucocorticoids, gonads, prostaglandins), are the starting material (cholesterol) for the synthesis of bile acids. 4. Stimulate a number of cellular metabolism processes. 5. Stimulate a number of processes of non-specific immunity, in particular, bind viruses from the cell membrane. 6. They perform a protective function, due to the fact that they are a shock absorber for injuries for internal organs (fat capsules of internal organs). 7. It is a source of endogenous water: 107 ml of water is formed from 100.0 g of fat. 8. Reduce surface tension, e.g. alveoli (phospholipids will form surfactant in the lungs). 9. Glycolipids (cerebrosides and gangliosides) inactivate some bacterial poisons. 10. Participate in thermoregulation: as a source of heat formation; as a biological thermal insulation system (by the power of neutral fat in the subcutaneous tissue). 11. They are carriers of fat-soluble vitamins A, D, E, K.12. Promote the absorption of fat-soluble vitamins A, D, E, K.

Complex lipids and steroids

1. Phospholipids contain: fatty acids; Alcohols; nitrogenous bases; phosphoric acid. Phospholipids include phosphatidylcholines (lecithins): kephalins; sphingomyelins. 2. Glycolipids contain: fatty acids; Alcohols; some monosaccharides. Glycolipids include cerebrosides and gangliosides. 3. Steroids. These include: cholesterols; vitamins of group D; bile acids; steroid hormones.

The synthesis of lipids ensures the differentiation of brain cells, the myelination of nerve fibers, and the structure of cell membranes. Cholesterol is an integral part of atherosclerotic changes in the vascular wall and an ascending material for the synthesis of bile acids and steroid hormones.

In young children, there is an instability in the regulation of fat metabolism and rapid depletion of fat depots. During periods of increased growth and sexual development, weight loss is often observed, due to the increased production of somatotropin and thyroid hormones. In the mild depletion of the fat depots of children, an increased tone of the sympathetic nervous system plays a significant role. In infancy, the child should receive 6-7 g of fat per 1 kg of body weight. At preschool and school age — 2.5–3.0 g of fat per 1 kg of body weight. It should be remembered that excess fat in a child's food is harmful, because it can easily lead to a shift in acid-base balance towards acidosis. After the age of 25, the basal metabolism decreases by about 7.5% every next 10 years, and therefore elderly people often develop obesity, as a result of the discrepancy between the usual high excitability of the food center (appetite) and reduced energy expenditure. In extreme old age, weight loss usually occurs due to a decrease in the excitability of the food center and a weakening of synthetic processes, in particular the conversion of carbohydrates into fats. Cholesterol and other steroids enter the body with food or are formed in the body. The highest concentration of cholesterol was found in the adrenal glands — 4.5–10%, in the brain and peripheral nerves — about 2%, in adipose tissue — about 2%, in the blood — 0.2%, in muscles — 0.1%, and in the skeleton — 0.01%. In the brain and nerve fibers it is in a free state, in other tissues both in a free and bound state, that is, in the form of cholesterol esters (cholesterolesters). The main site of cholesterol formation is the liver. The body of a person with a body weight of 70 kg contains from 105 to 175 g of cholesterol, and most of it is cholesterol synthesized in the liver. The liver also receives dietary cholesterol absorbed from the intestines. Both cholesterols are included in the liver as part of □-□-lipoproteins, that is, complex compounds of lipids with proteins, and in this form enter the bloodstream. The physiological content of complexation consists in the formation of soluble compounds that can be carried by the bloodstream to the tissues. With aging, along with an increased content of lipids in the blood, an increased content of cholesterol

is established. At birth, the cholesterol content is very low — 0.5–0.8 g/L (1.3–2.1 mmol/L). One week after birth, cholesterol levels rise to 1.5–1.6 g/L (3.9–4.2 mmol/L) at the end of Year 1.

Lipid requirements at different ages. *In the fetus* , the energy needs are satisfied by the carbohydrates of the mother's blood, so fats are used mainly as a plastic material. By the end of pregnancy, 600.0–700.0 g of fat is stored in the fetus's body as an energy reserve. Fats do not pass through the placenta, therefore they are synthesized in the fetal body from glucose. The energy reserve is represented mainly by brown fat, the oxidation of which is an essential mechanism of heat production. *In the prenatal period* , when the environment changes, large energy expenditures occur, which leads, first of all, to the mobilization of carbohydrates and, as a result, to the development of hypoglycemia, which in turn stimulates fat oxidation. In the prenatal period, the baby loses approximately 150.0 g of fat. In infants, 80% of the energy requirements are met by the oxidation of fat from the mother's milk. By the end of the 1st month of life — 50%; later in children — 30-35%; in adults — 30-50% due to oxidation of fat ingested with food. The accumulation of fat in the child's body without significant sex differences occurs by the age of 12. Subsequently, sex differences appear in terms of the amount and distribution of fat. With the fats of food, the body receives some fatty acids, including three biologically valuable essential acids - linoleic, linolenic and arachidonic, necessary for normal growth and normal function of the skin. The daily human requirement for essential fatty acids is 3.0–6.0 g per day. With fats, vitamins A, D, E, K, soluble in them, necessary for the growth and development of the child, are delivered. When compiling a diet for children, it is necessary to take into account not only the quantity, but also the quality of the fats included in it. Without fats, it is impossible to develop general and specific immunity. The need for fat changes with age. The most relative (per 1 kg of weight) fat intake occurs in infants. During this period, 50% of the total caloric requirement is provided by fat. As age increases, more and more energy is generated in the body due to carbohydrates. The need for fat per 1 kg of body weight is: in infancy - 4-6 g; 2-6 years old - 3-3.5 g; in 6-10 years - 1-3 g, in adults - 1 g/kg. With age, the daily amount of fat necessary for the normal development of children increases. From one to three years old, the child should receive 32.7 g per day; from 4 to 7 years old - 39.2 g; from 8-13 years old — 38.4; from 14 to 17 years old — 47 g, which approximately corresponds to the norm of an adult (50 g according to the norms of the Institute of Nutrition of the Academy of Medical Sciences of the USSR). In schoolchildren with a high mental load in high school, the need for lipids is higher, they should be supplied with food 100.0–104.0 g per day with a ratio of fats of animal and vegetable origin of 2.3:1. For better use of fat, it is necessary to introduce carbohydrates into the child's diet in a ratio of 1:3, at least 1:2, that is, carbohydrates should be 2-3 times more than fat. Proper breakdown of fats is only possible if the fats are properly correlated with other essential nutrient ingredients. Breastfed babies absorb almost all the fat in human milk. In breastfed children, 96% of fat is absorbed, with mixed and artificial feeding — 90%.

Aging:1. One of the characteristic features of changes in metabolism is the reorientation of anabolic processes — the switching of anabolic synthesis of proteins, which form the basis of the active part of tissues and organs, to the synthesis of fat. In the body of adults, the amount of fat in fat depots is much greater than in young people. In the heart, muscles, liver, the amount of fat does not increase.2. The rate of synthesis and self-renewal of phospholipids decreases. 3. The concentration of sterols (cholesterol) in the blood and in the tissues increases, especially in tissues with reduced metabolism, apparently due to shifts in metabolic regulatory systems.

Regulation of lipid metabolism. The regulatory parameter for the regulation of fat metabolism is the content of glucose in the blood. The processes of fat deposition and its mobilization from fat depots with subsequent use in tissues are carried out according to the principle of self-regulation. It is based on the level of blood glucose or tissue fluid that washes adipose tissue. An increase in the concentration of glucose in the blood reduces the breakdown of triglycerides and activates their synthesis. On the contrary, with a decrease in the concentration of blood glucose, the synthesis of triglycerides is inhibited, their breakdown is enhanced, and non-esterified fatty acids enter the blood from adipose tissue. Thus, the relationship between fat and carbohydrate metabolism is carried out in providing energy to the body: with an excess of one of the energy sources (glucose), triglycerides are

deposited in adipose tissue; When there is a lack of carbohydrates (hypoglycemia) or insufficient use (diabetes mellitus), triglycerides are broken down and release new energy material into the blood - non-esterified fatty acids. These processes of self-regulation are under the influence of nervous and endocrine influences. Nervous regulation of fat metabolism is provided primarily by the activity of the hunger center in the hypothalamus. However, there is the concept of a food center, which is a functional association of neurons located at different levels of the brain — in the cortex of the large hemispheres, in the subcortical parts that lie below, in the brain stem. A special role is played by nerve formations located in the posterior hypothalamus, the so-called ventrolateral and ventromedial nuclei. The electrical destruction of the ventrolateral nuclei causes a complete lack of appetite in animals, up to death from starvation. When the ventromedial nuclei are destroyed, a long-term nutritional disorder occurs, as a result of which the animals eat unusually large amounts of food, and they develop obesity. Thus, in white rats, after the destruction of ventromedial nuclei, weight gain increased 10 times compared to the control. The regulatory influences of the central nervous system are transmitted to the fat depot by the autonomic nerves — sympathetic and parasympathetic. Impulses transmitted by sympathetic nerves inhibit the synthesis of triglycerides and enhance their breakdown (lipolysis). An increase in the tone of the parasympathetic nervous system contributes to the deposition of fat.

Hormonal regulation. **The fat-mobilizing effect is characteristic of the following hormones:**

1. Adrenaline and norepinephrine of the adrenal medulla. A condition in which the content of these hormones in the blood increases and disorders of the sympathetic nervous system (emotional arousal, prolonged muscle activity) leads to the depletion of fat depots. 2. Somatotropin of the anterior pituitary gland. 3. Thyrotropin and thyroid hormones. Therefore, in children, adolescents and young adults, periods of intensive growth, hormones that provide anabolic processes, limit the deposition of fat in fat depots. Slow growth rates are clearly coupled with excess fat deposition in the body. 4. Beta-lipotropin of the anterior pituitary gland. It is believed that this is a specific hormone that has a pronounced lipolytic effect. 5. Glucagon.

Inhibit fat mobilization:

1. Glucocorticoids and ACTH of the adrenal cortex inhibit fat mobilization, as they promote the deposition of glycogen in the liver and increase blood glucose levels. 2. Insulin – activates the conversion of carbohydrates into fats and inhibits the breakdown of fat. 3. Prolactin of the anterior pituitary gland activates fat synthesis, so excessive production of this hormone in women during lactation and after it leads to obesity.

Equipment: textbooks, manuals, guidelines on the topic of the seminar, multimedia projector, laptop, interactive whiteboard.

Plan:

Organizational measures:

- Greeting
- checking attendees,
- communication of the topic, purpose of the lesson,
- motivation of higher education students to study the topic.

Control of the basic level of knowledge:

- Written work
- written testing,
- Frontal survey on basic terminology

Questions (test tasks) to test basic knowledge on the topic of the seminar:

1. Which hormone stimulates protein synthesis in the liver?
Aldosterone
Calcitonin
C. Кортизол
Somatotropic hormoneSomatotropic hormone
Testosterone

2. Which hormone stimulates fat synthesis?
Adrenaline
B. Thyroxine
Glucocorticoids
D. Glucagon
Insulin

3. Somatotropic hormone of the adenohypophysis carries out:
Anabolic effect on the metabolism of fats and proteinsAnabolic effect on the metabolism of fats and proteins
Catabolic effect on the metabolism of fats and proteinsCatabolic effect on the metabolism of fats and proteins
C. Anabolic effect on fat metabolism and catabolic effect on carbohydrate metabolism
Catabolic effect on carbohydrate metabolism and anabolic effect on protein metabolism
Anabolic effect on protein metabolism and catabolic — on fat metabolism

4. Patient S., 36 years old, complained of obesity and increased swelling against the background of a strict diet. Objectively detected: hyperglycemia, hypernatremia, hyperstenuria. What endogenous disorders can be assumed?
Hypofunction of the thyroid gland
Hyperfunction of the adrenal cortexHyperfunction of the adrenal cortex
Hyperfunction of the ovaries
Hypofunction of the thyroid glandHypofunction of the thyroid gland
Hypofunction of the parathyroid glandsHypofunction of the parathyroid glands

5. A derivative of carbohydrate metabolism that is not synthesized in the body:
Фолий aFolic acid
Ascorbic acid
Cyanocobalamin
Biotin
Riboxin

6. Central glucoreceptors are located in:
Anterior hypothalamusAnterior hypothalamus
Posterior hypothalamus
C. Mosti
Cerebellum
Cori of large hemispheres

7. Promotes Glucose Utilization by Cells:
A. Glucagon
B. Adrenaline
Insulin
Thyroxine
Somatotropic hormoneSomatotropic hormone

8. A decrease in the concentration of glucose in the blood leads to an increase in secretion:
Acetylcholine
Histamine
Adrenaline
Serotonin
Dopamine

9. A person was admitted to the emergency department with complaints of heart palpitations, weakness and tremor of muscles, dizziness, increased sweating. From the anamnesis, it is known that for 10 years he has been suffering from diabetes mellitus, regularly takes hypoglycemic drugs. The person was injected:
Insulin
Solution of glucoseSolution of glucose
Sodium chloride
Magnesium sulfateMagnesium sulfate
E. Calcium chloride

10. Derivatives of carbohydrate metabolism that are synthesized in the body, except:
Фольической ошикий оFolic acid
Ascorbic acid
Cyanocobalamin
Biotin
Riboxin

Answers: 1.D, 2.E, 3.A, 4.B, 5.A, 6.A, 7.C, 8.C, 9.B, 10.A.

Discussion of theoretical issues: in the form of answers to questions, disputes, discussions, presentations, abstracts, discussion of reports and abstracts, reviewing the answers of higher education applicants, etc.

Fat metabolism is a set of processes of conversion and use of fats (lipids). The breakdown of 1 g of fat releases 38.9 kJ (9.3 kcal) of energy (2 times more than the breakdown of 1 g of protein or carbohydrates). Fats are compounds that include fatty acids and glycerol. Fatty acids under the action of enzymes of the pancreas and small intestine, as well as with the participation of bile, are absorbed into the lymph in the villi of the small intestine. Further, with the lymph flow, lipids enter the blood stream, and then into the cells.

Like carbohydrates, fats break down into carbon dioxide and water and are excreted in the same way. The endocrine glands and their hormones are involved in the humoral regulation of fat levels.

Meaning of Fats:

A significant part of the energy needs of the liver, muscles, kidneys (but not the brain!) is covered by the oxidation of fats. Lipids are structural elements of cell membranes, are part of mediators,

hormones, form subcutaneous fat deposits and omentum. Deposited in reserve in the connective tissue membranes, fats prevent displacement and mechanical damage to organs. Subcutaneous fat does not conduct heat well, which helps to maintain a constant body temperature. The need for fats is determined by energy needs of the body as a whole and averages 80 - 100 g per day. Excess fat is deposited in the subcutaneous adipose tissue, in the tissues of some organs (for example, the liver), as well as on the walls of blood vessels.
If the body lacks some substances, then they can be formed from others. Proteins can be converted into fats and carbohydrates, and some carbohydrates can be converted into fats. In turn, fats can become a source of carbohydrates, and the lack of carbohydrates can be replenished by fats and proteins. However, neither fats nor carbohydrates can be converted into proteins.

It is estimated that an adult needs at least 1500 - 1700 kcal per day for normal life. Of this amount of energy, 15-35% is spent on the body's own needs , and the rest is spent on generating heat and maintaining body temperature.

Topics of reports / abstracts: when preparing a report, abstract, analytical review, etc., students can, along with this, prepare didactic visual materials in the form of tables, codegrams, slides, drawings, drug diagrams, etc. For example, "The physiological role of carbohydrates and the features of their metabolism".
Summing up.
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5. Sembulingam K. Essentials of Medical Physiology / K. Sembulingam, P. Sembulingam. – Jaypee Brothers Medical Publishers. – 9th ed., 2022. –1022 p.

Electronic Information Resources
- Official website of the Department of Physiology of ONMedU https://info.odmu.edu.ua/chair/physiology/files
- Testing Center – Krok-1 Licensed Test Items Database https://www.testcentr.org.ua/uk/
- National Scientific Medical Library of Ukraine http://library.gov.ua/
- V.I. Vernadsky National Library of Ukraine http://www.nbuv.gov.ua/
- Ministry of Health of Ukraine: official website. URL: https://moz.gov.ua/.
- National Health Service of Ukraine: official website. URL: https://nszu.gov.ua/pro-nszu
- National Academy of Medical Sciences of Ukraine. URL: www.amnu.gov.ua.
- European Health for All Database. URL: http://medstat.gov.ua/ukr/statreports.html.