

МИНИСТЕРСТВО НАУКИ И ВЫСШЕГО ОБРАЗОВАНИЯ
РОССИЙСКОЙ ФЕДЕРАЦИИ

Федеральное государственное бюджетное
образовательное учреждение высшего образования
«Пензенский государственный университет» (ПГУ)

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ОЖИРЕНИЕ И ИЗБЫТОЧНЫЙ ВЕС У ДЕТЕЙ

Учебное пособие

L. I. Krasnova

OBESITY AND OVERWEIGHT IN CHILDREN

Manual

Пенза
Издательство ПГУ
2025

УДК 613.25-053.2(075)

К78

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К78

Ожирение и избыточный вес у детей : учеб. пособие /
Л. И. Краснова = Obesity and overweight in children : manual /
L. I. Krasnova. – Пенза : Изд-во ПГУ, 2025. – 36 с.

ISBN 978-5-907934-81-8

Представлена информация об ожирении и избыточной массе тела у детей,
отражающая вопросы этиологии, эпидемиологии, клинических особенностей
и диагностики, а также современные методы терапии.

Издание подготовлено на кафедре педиатрии ПГУ и предназначено для
обучающихся по специальностям 31.05.01 «Лечебное дело» и 31.05.02 «Педиат-
рия».

The manual provides information on obesity and overweight in children,
reflecting issues of etiology, epidemiology, clinical features and diagnostics, as well as
modern methods of therapy.

The publication was prepared at the Department of Pediatrics of PSU and is
intended for the students majoring in 31.05.01 “General Medicine” and 31.05.02
“Pediatrics”

Рекомендовано

*к изданию методической комиссией Медицинского института ПГУ
(протокол № 06 от 13.02.2025)*

УДК 613.25-053.2(075)

ISBN 978-5-907934-81-8

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университет, 2025

CONTENTS

Abbreviations	4
Definition and epidemiology of obesity	5
Etiology of obesity	5
Pathogenesis of obesity	5
Leptin melanocortin system	7
Clinical picture of obesity	9
Diagnosis of obesity	10
Treatment of obesity.....	13
Obesity prevention	17
Outpatient observation of obesity	18
Clinical case of obesity in a child.....	18
Test control.....	22
Clinical tasks	31
Standard answers to the test tasks	32
Standard answers to the problems.....	32
References	34

Abbreviations

WHO – World Health Organization
LEP – leptin
LEPR – leptin receptor
POMC – proopiomelanocortin
CP1 – convertase-1
ACTH – adrenocorticotrophic hormone
 α -MSH – α -melanocyte-stimulating hormone
TG – triglycerides
BMI – body mass index
SDS – Standard Deviation Score
ALT – alanine aminotransferase
AST – aspartate aminotransferase
HDL – high-density lipoproteins
LDL – low-density lipoproteins
OGTT – glucose tolerance test
DM – diabetes mellitus
BP – blood pressure
MRI – magnetic resonance imaging
GLP-1 – glucagon-like peptide-1
HR – heart rate
Echo CG – echocardiography
LV – left ventricle
ABPM – ambulatory blood pressure monitoring
CBC – complete blood count
GUA – general urine analysis
ECG – electrocardiogram

Definition and epidemiology of obesity

Obesity is a heterogeneous group of hereditary and acquired chronic diseases associated with excessive accumulation of fatty tissue in the body.

According to the World Health Organization (WHO), more than a billion people on the planet are overweight. In 2014, more than 500 million people were registered as obese. At the same time, 30 million children and adolescents in the European region are overweight and 15 million are obese.

Overweight and obesity among school-age children currently reach 25–30 %.

One of the most negative trends is the increase in cases of overweight in young children. According to WHO estimates, current trends could lead to obesity in 70 million children under the age of 5 by 2025.

Etiology of obesity

Obesity is a multifactorial disease that occurs as a result of a certain interaction of genetic and non-genetic causes. Ninety seven chromosomal regions associated with the development of obesity have been identified.

The most common type of obesity, caused by excess calorie intake in conditions of physical inactivity and hereditary predisposition, is constitutional-exogenous (simple, idiopathic) obesity.

Much less frequently, obesity in childhood and adolescence is associated with the use of medications (for example, glucocorticosteroids, antidepressants, neuroleptics (antipsychotics), antiepileptic drugs) or the presence of diseases (tumors of the hypothalamus and brainstem, radiation therapy for brain tumors and hemoblastoses, head trauma, stroke, hypercorticism, hypothyroidism and other neuroendocrine diseases, chromosomal abnormalities).

Pathogenesis of obesity

The main risk factors of overweight and obesity in children are:

1) unbalanced diet (excessive consumption of high-calorie foods, including fast food, sugary carbonated drinks/juices; large portions; no breakfast; insufficient vegetables and fruits in the diet; watching TV during meals; eating out with peers);

- 2) physical inactivity;
- 3) the influence of education and family factors;
- 4) insufficient duration and sleep disturbances;
- 5) psychological factors (excessive food consumption when stress, negative emotions);
- 6) changes in the intestinal micro-bio-enosis.

It has been established that the factors programming obesity act at the early stages of development (fetus – newborn – young child).

Factors contributing to early obesity are:

- excess body weight of parents;
- significant weight gain during pregnancy;
- carbohydrate metabolism disorders during pregnancy (gestational diabetes);
- maternal smoking during pregnancy;
- cesarean section;
- birth of large children and children with intrauterine growth retardation;
- early artificial feeding;
- rapid weight gain of the child in the first two years of life.

According to the results of recent studies, one of the factors that reduces the risk of obesity is adequate microbial colonization of the intestines of a newborn child, which is determined not only by the health of the mother, the diversity of the maternal microbiota, but also by the method of delivery, since the first contact of the human body with microorganisms occurs during childbirth. Already at this stage, two options for the establishment of microbiota are possible. During childbirth through the natural birth canal, populated mainly by *Lactobacillus spp.*, *Prevotella spp.*, *Autopodium spp.* and *Sneathia spp.*, the child receives this set of microorganisms, and they predominate in the first months of life. During birth by cesarean section, the child's first contact occurs with the skin microbiota, the equipment of the maternity ward, and its initial set of microorganisms will be represented *Staphylococcus spp.*, *Corynebacterium spp.* and *Propionibacterium spp.*

Another important risk factor for obesity is decreased sleep duration in infants. It is believed that decreased sleep time reduces leptin levels and increases ghrelin concentrations, which is accompanied by increased appetite. Another mechanism for the relationship between sleep and excess body weight is an increase in the number of feedings during prolonged wakefulness and restlessness of the child, especially at night.

Leptin melanocortin system

This system is key in the regulation of feeding behavior and energy metabolism. It is activated by leptin (LEP), which is secreted by adipocytes, but exerts its effect through the leptin receptor (LEPR) of the arcuate nuclei of the hypothalamus, leading to the activation of proopiomelanocortin (POMC). Under the influence of the enzyme prohormone convertase-1 (CP1), adrenocorticotrophic hormone (ACTH) and α -melanocyte-stimulating hormone (α -MSH) are formed from POMC, which, in turn, activates the MC4R receptor in the paraventricular nuclei, which leads to satiety signaling.

Theoretically, the more leptin, the less food intake. The simplest hypothesis of the pathogenesis of obesity assumed that obese children have either an absolute deficiency of leptin or abnormalities in its production, as well as abnormalities in the structure of this hormone itself or its receptors, but this was not confirmed later (table 1).

Table 1

Monoamines and peptides that affect appetite regulation

Orexigenic effects	Anorexic effects
Norepinephrine (alpha2 receptors)	Norepinephrine (alpha1-, beta2- receptors)
Neuropeptide Y	Serotonin
Beta-endorphin	Cholecystokinin
Somatoliberin	Melanocyte Stimulating Hormone
Galanin	Corticoliberin
Ghrelin	Leptin
Somatostatin	Enterostatin
	Glucagon
	Tyroliberin

Eating behavior is influenced by neuropeptide Y, cholecystokinin, leptin, endorphins, some amino acid sequences (fragments of the ACTH molecule), etc.

An increase in plasma insulin levels stimulates the synthesis of free fatty acids in the liver; in adipose tissue, insulin increases the penetration of glucose into adipocytes, most of which is used to synthesize triglycerides (TG). Insulin enhances lipogenesis (fig. 1).

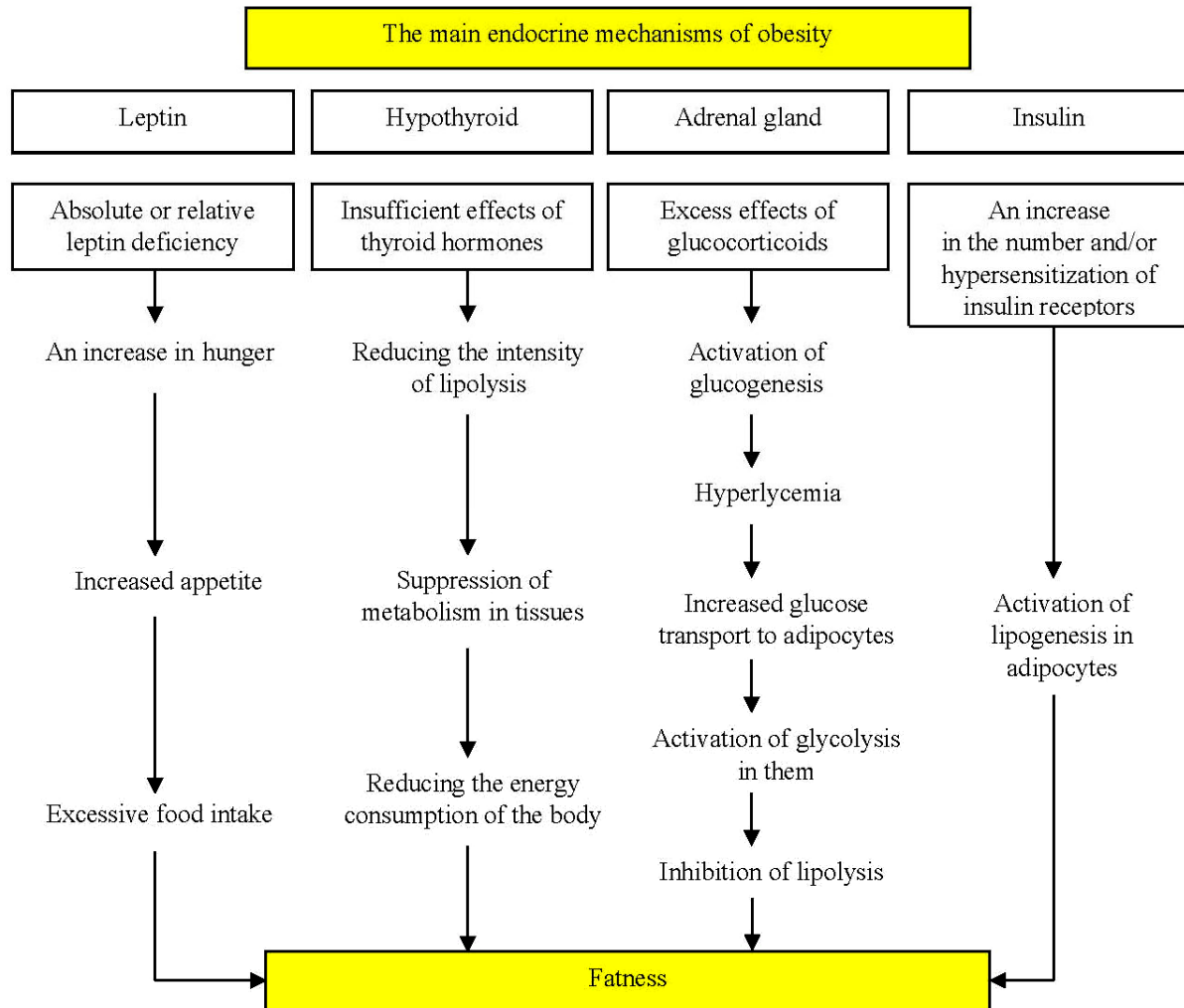


Fig. 1. The main endocrine mechanisms of obesity

Classification of obesity:

1. ICD-10:

- E 66.0. Obesity due to excess energy intake.
- E 66.1 Drug-induced obesity.
- E 66.2 Extreme obesity with alveolar hypoventilation.
- E 66.8. Other forms of obesity.
- E 66.9. Obesity, unspecified.
- E 67. Other types of nutritional excess.
- E 67.8. Other specified forms of overnutrition.
- E 68. Consequences of overnutrition.

2. By etiology:

- simple (constitutional-exogenous, idiopathic) expectation deficiency associated with excess calorie intake in conditions of hereditary predisposition;
- hypothalamic obesity associated with the presence and treatment tumors of the hypothalamus and brainstem, radiation therapy for brain tumors, head trauma or stroke;
- obesity in neuroendocrine diseases (hypothyroidism, etc.);
- iatrogenic obesity (caused by long-term intake of corticosteroids, antidepressants and other drugs);
- monogenic obesity due to mutations of leptin genes, re- leptin receptor, melanocortin receptors of types 3 and 4, pro- opiomelanocortin, proconvertase type 1;
- syndromic obesity (with chromosomal disorders).

3. By the presence of complications and comorbid conditions:

- carbohydrate metabolism disorders (impaired glucose tolerance)
- impaired fasting glucose, insulin resistance, diabetes mellitus;
- non-alcoholic fatty liver disease (fatty hepatosis and steatohepatitis as the most common conditions in children);
- dyslipidemia;
- arterial hypertension;
- delayed sexual development;
- accelerated sexual development;
- hyperandrogenism syndrome;
- apnea/hypopnea syndrome;
- disorders of the musculoskeletal system (osteoarthritis).

4. By degree of obesity:

- I degree – SDS BMI 2.0–2.5;
- II degree – SDS BMI 2.6–3.0;
- III degree – SDS BMI 3.1–3.9;
- Morbid – SDS BMI ≥ 4.0 .

Clinical picture of obesity

The clinical picture is determined by the etiopathogenetic form of obesity.

The most numerous groups, which accounts for up to 98–99 % of all cases of obesity, is simple (constitutional-exogenous, idiopathic) obesity.

The onset of the disease most often occurs after 5 years or during puberty. As a rule, obesity progresses gradually against the background of good (often accelerated) growth rates. The presence of striae, follicular keratosis, polyphagia, black acanthosis, arterial hypertension, etc. does not always correlate with the degree of obesity. The presence of excess body weight and obesity in relatives (parents, grandparents) is typical.

Hypothalamic obesity in most cases is characterized by a rapidly progressive nature, develops after surgery (radiation therapy), less often – precedes the period of diagnosis. In the case of craniopharyngioma, most patients are characterized by a slowdown in growth rates, and in the case of gliomas – symptoms of premature sexual development; neurological complaints (headaches, visual impairment) depend on the location and progression of the tumor.

Children with hypothalamic obesity often have sleep-wake rhythm disorders, as well as behavioral disorders.

Syndromic forms of obesity are characterized by early onset and rapid progression. Most syndromic forms are characterized by delayed neuropsychic development from moderate to severe severity, and the presence of organ-specific developmental anomalies.

Monogenic forms of obesity are extremely rare and are characterized by early onset (from the first months of life to 1 year) and polyphagia. Most patients have normal neuropsychic development.

Monogenic forms of obesity arise due to a mutation in one of the genes encoding proteins of the leptin-melanocortin system.

Diagnosis of obesity

The body mass index (BMI) is calculated as the ratio of body weight in kilograms to the square of a person's height, expressed in meters. BMI has been shown to correlate with the amount of fat tissue in the body in both adults and children. Criteria for excess body weight in children are determined based on percentile tables or standard deviations of BMI (*Standard Deviation Score* – SDS). They take into account not only the height and weight, but also the gender and age of the child (fig. 2).

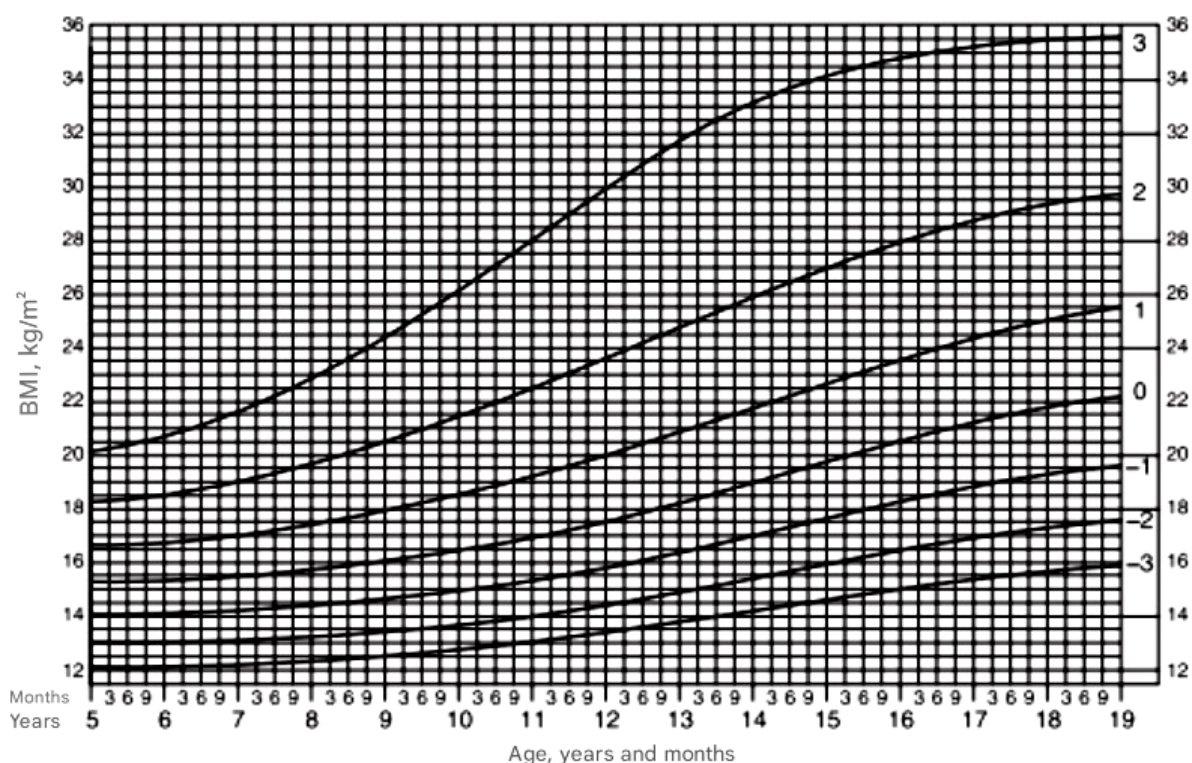


Fig. 2. Dynamics of body mass index in boys aged 5 to 19 years

Taking into account the WHO recommendations, obesity in children and adolescents from 0 to 19 years should be defined as a BMI equal to or more than +2.0 SDS BMI, and overweight as a BMI equal to +1.0...+2.0 SDS BMI. Normal body weight is diagnosed with BMI values within ± 1.0 SDS BMI.

Anthropometric measurements include waist circumference. This indicator reflects the amount of visceral adipose tissue. Exceeding waist circumference ≥ 90 th percentile indicates the presence of abdominal obesity and serves as a marker of insulin resistance.

Complaints and anamnesis

When collecting anamnesis, the following are determined:

- birth weight;
- age of onset of obesity;
- psychomotor development;
- hereditary history of obesity (including height and weight of parents);
- type 2 diabetes mellitus and cardiovascular diseases;
- growth and weight dynamics;
- presence of neurological complaints (headaches, visual impairment).

Laboratory diagnostic tests

Diagnosis of obesity should include screening for complications of obesity.

Main complications of obesity:

- carbohydrate metabolism disorders (impaired fasting glycemia, impaired glucose tolerance, diabetes mellitus);
- disorders of lipid metabolism (hypercholesterolemia, hypertriglyceridemia, glyceridemia and various mixed dyslipidemias);
- fatty hepatosis / steatohepatitis;
- arterial hypertension;
- menstrual irregularities in girls (testicular dysfunction, polycystic ovary syndrome, etc.);
- pathology of the musculoskeletal system;
- psychological problems.

For screening of obesity-associated diseases, it is recommended to determine the presence and nature of striae, follicular keratosis, *acanthosis nigricans*, androgen-dependent dermopathy (in girls – hirsutism, acne, oily seborrhea).

All patients with obesity are recommended to undergo a biochemical blood test to screen for complications, to identify lipid metabolism disorders, to determine the activity of alanine aminotransferase (ALT) and aspartate aminotransferase (AST) in it, in combination with an ultrasound examination of the abdominal organs (liver).

The diagnosis of dyslipidemia is established in the presence of two or more of the following indicator values:

- cholesterol – 5.2 mmol/l;
- triglycerides – >1.3 (for children under 10 years), >1.7 (for children over 10 years) mmol/l;
- high-density lipoproteins (HDL) – ≤ 0.9 (boys) and ≤ 1.03 (girls) mmol/l;
- low-density lipoproteins (LDL) – 3.0 mmol/l. ALT activity exceeding the upper limit of the norm established for this laboratory in children with signs of non-alcoholic

The detection of fatty liver disease by ultrasound examination (ultrasound), in the absence of other causes of cytolysis' syndrome (viral, metabolic liver damage, etc.) is regarded as a manifestation of steatohepatitis.

All patients with obesity over 10 years of age are recommended to undergo a glucose tolerance test (OGTT) to determine fasting glucose and glucose after 120 minutes to identify carbohydrate metabolism disorders.

In clinically manifest diabetes mellitus (DM), OGTT is not recommended. In this case, carbohydrate metabolism disorders can be diagnosed using fasting, postprandial, or daytime glycemia values and glycated hemoglobin levels.

All children with obesity and overweight are recommended to have their blood pressure (BP) measured and assessed based on gender, age and height to detect arterial hypertension.

Nocturnal polysomnography is performed on children and adolescents with obesity and clinical signs of obstructive sleep apnea syndrome: increased daytime sleepiness, snoring during sleep, and cessation of breathing during sleep.

It is recommended to assess actual nutrition using the 24-hour (daily) nutrition reproduction method with the help of a food diary, in order to prescribe diet therapy or its correction.

Conducting additional studies (hormonal profile study, magnetic resonance imaging (MRI) of the brain, molecular genetics and cytogenetic methods) in children and adolescents with obesity is recommended only if hypothalamic, syndromic, endocrine or monogenic forms of obesity are suspected.

Treatment of obesity

Lifestyle modification (diet therapy, increased physical activity and correction of eating behavior) of children and adolescents with obesity or overweight, as well as their family members, is the basis of obesity therapy and its prevention. In case of ineffectiveness of lifestyle modification, pharmacological agents may be used.

Necessary conditions for effective treatment

1. Limitation of sweet drinks: ban (consumption of no more than one serving no more than once a week) not only carbonated sweet drinks, but also juices, compotes, fruit drinks with permission to take drinking water at the child's request.
2. Limit sweet fruits to 1 serving (100 g) per day.
3. At least four meals a day, mandatory breakfast.
4. Ban on sweet dairy products.
5. Control of portion size / quantity.

6. Enriching the diet with vegetables (for young children – 300 g, for teenagers – 400 g per a day with limited consumption of such quantities of potatoes as the only vegetable), dietary fiber, whole grain products.

7. Teaching children to eat slowly without a computer television/mobile support.

Children and adolescents from 6 to 17 years old with obesity and overweight need daily physical activity of moderate and high intensity (including as part of a prescribed set of exercises (therapeutic exercise)) for a total of at least 60 minutes.

For children from 1 to 4 years old, various types of physical activity of any intensity are recommended for a total of at least 180 minutes per day to prevent excess body weight and obesity (for example, various games: lying on the floor, with toys, crawling, gymnastics for babies, etc. If the child cannot crawl yet, it is recommended to spend at least 30 minutes per day lying on his stomach).

For children and adolescents with obesity and overweight, in order to prevent physical inactivity, it is necessary to reduce inactive time spent in front of a TV screen or computer monitor to 2 hours a day or less.

The use of pharmacotherapy (in combination with lifestyle changes) in children and adolescents with obesity is recommended from the age of 12 years if measures aimed at forming a healthy lifestyle, which lasted at least 1 year, have been ineffective.

Liraglutide is a glucagon-like peptide-1 (GLP-1) analogue. At the hypothalamic level, liraglutide, by activating GLP-1 receptors, enhances satiety signals and reduces hunger signals, thereby reducing food intake.

The drug is administered subcutaneously once a day at any time, regardless of food intake, in the abdomen, thigh or shoulder. The initial dose is 0.6 mg per day, followed by standard titration of the drug dose according to the instructions: the dose is increased by 0.6 mg at intervals of at least one week. The dose of the drug should be increased until a value of 3.0 mg (therapeutic dose) is reached.

Orlistat is an inhibitor of gastric and pancreatic lipases, which participate in the hydrolysis of triglycerides and are necessary for the absorption of fats in the small intestine. As a result of the drug's action, the breakdown of dietary fats is disrupted and their absorption is reduced. After the drug is discontinued, its action quickly ceases, and lipase activity is restored.

Orlistat is prescribed 1 capsule (120 mg) before main meals, the maximum daily dose is 360 mg (3 capsules, 1 capsule 3 times a day). The duration of treatment can be from 3 to 12 months.

Surgical treatment

Surgical methods of treating obesity (bariatric surgery) can be recommended for adolescents with morbid obesity only if the following conditions are met:

1. BMI >35 kg/m² in combination with severe complications:
 - non-alcoholic steatohepatitis;
 - type 2 diabetes mellitus;
 - obstructive sleep apnea syndrome;
 - Blount's disease;
 - severe arterial hypertension).
2. BMI >40 kg/m² (SDS BMI >4.0 for a given gender and age) regardless of the presence of complications.
3. Physical development completed or close to completion (partial or complete closure of growth zones), reaching stage 4–5 of sexual development according to the Tanner scale.
4. Documented ineffectiveness of conservative-methods of treating obesity for 12 months in specialized centers.
5. Absence of mental illness and eating disorders behavior (including those caused by the presence of syndromic and hypothalamic forms of obesity).
6. Readiness / ability of the teenager and his family members for long-term strict and regular postoperative dynamic monitoring.

In obesity surgery in adolescents, laparoscopic access is preferred as the least invasive. Bariatric surgeries are divided into three groups:

- 1) restrictive (gastro-restrictive);
- 2) malabsorptive (bypass);
- 3) combined.

Restrictive surgeries are aimed at reducing the volume of the stomach. Weight loss occurs due to limiting the amount of food consumed and rapid satiety during meals. The most common gastro-restrictive surgeries include adjustable gastric banding and longitudinal resection of the stomach, and combined surgeries include various modifications of Roux-en-Y gastric bypass (fig. 3).

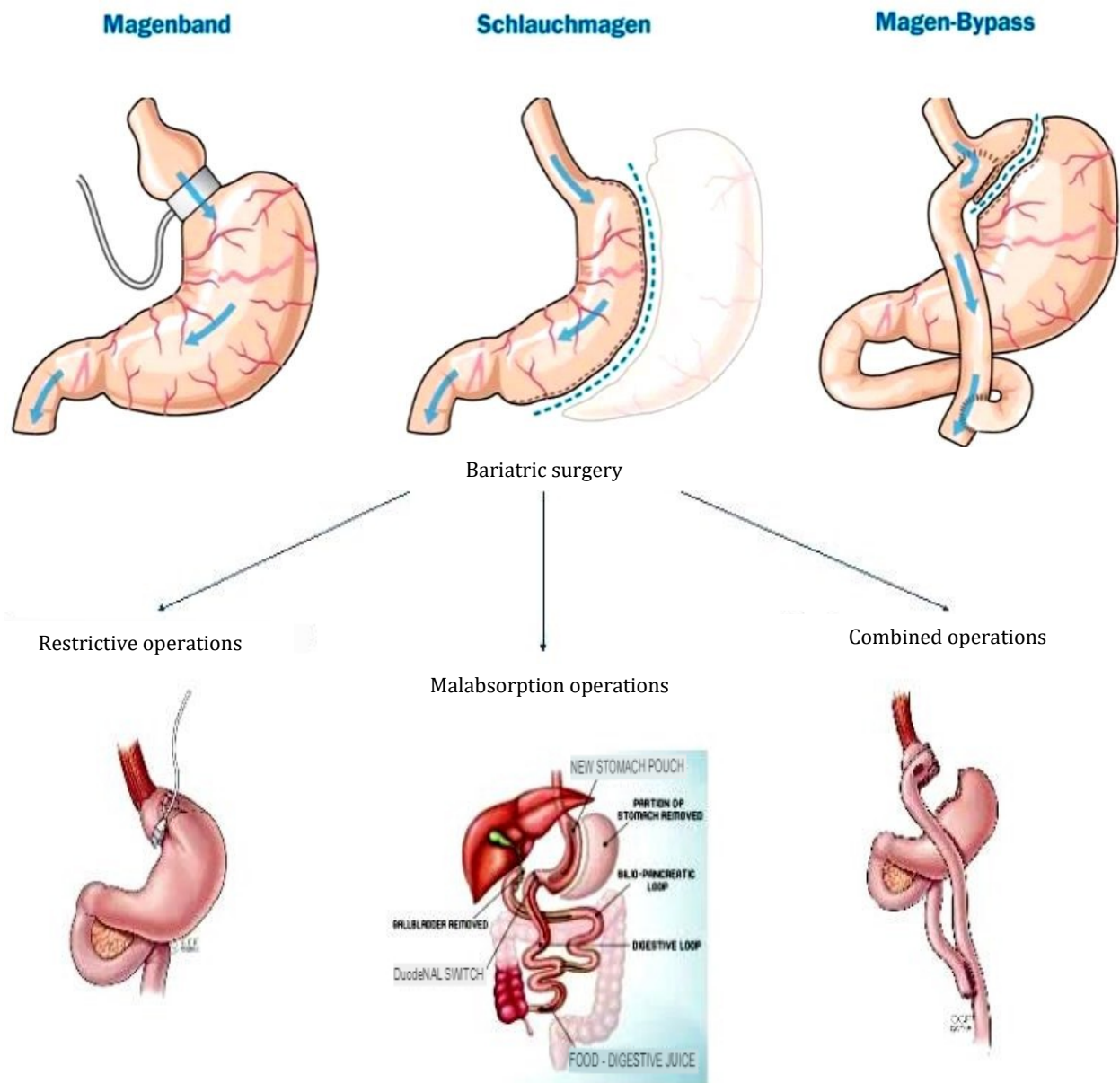


Fig. 3. Types of surgical treatment (beginning)

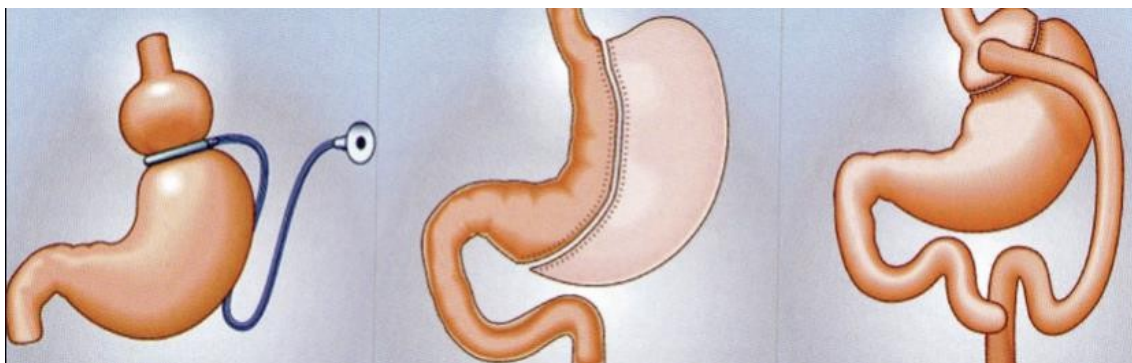
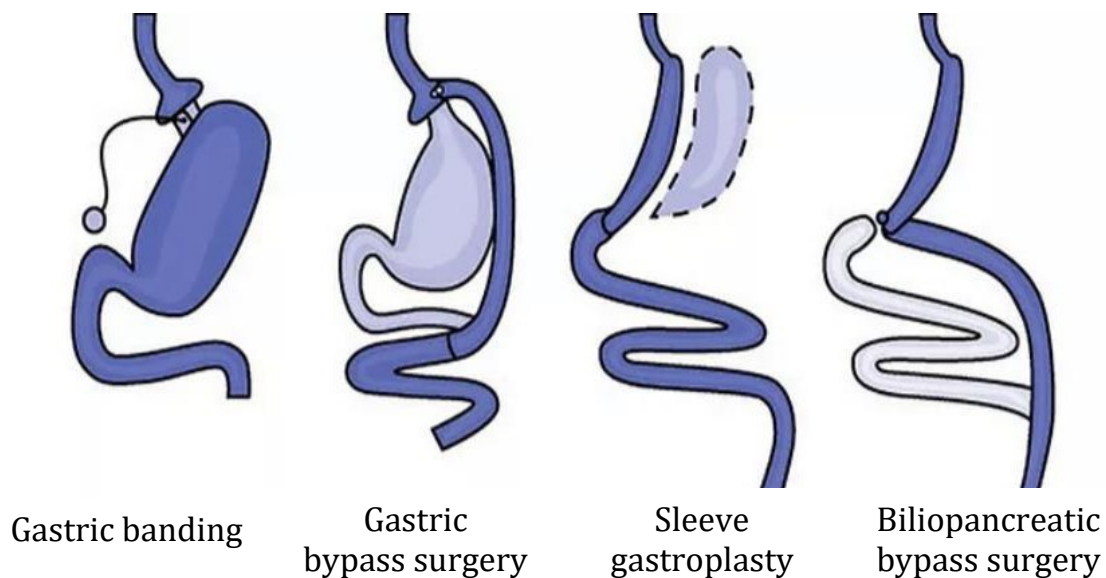


Fig. 3. Types of surgical treatment (end)

Obesity prevention

The following measures are identified for obesity prevention:

1. Timely diagnosis of obesity and early initiation of treatment the duration of the disease (1–2 years) of treatment and preventive measures, which helps to reduce the degree of obesity and the duration of the disease.
2. Increasing the level of knowledge of children and parents about a healthy lifestyle life: adherence to a daily routine, correction of eating behavior and reduction of food load in the evening / night time.
3. Priority of an active lifestyle: sports, exercise, children's games together with their parents.
4. Improving the health of the mother and normalizing her body weight at the stage of pregnancy planning.

Outpatient observation of obesity

For children and adolescents with overweight and obesity, dynamic observation with control of anthropometric indicators, assessment of BMI and actual nutrition is recommended.

Children under 1 year of age are observed by a pediatrician monthly. They undergo anthropometric monitoring, SDS BMI. If obesity develops, a consultation with a pediatric endocrinologist is recommended.

Young children (1–3 years old) are observed by a pediatrician once every 3–6 months. If obesity develops, a consultation with a pediatric endocrinologist is also indicated, and if there is a concomitant delay in psychomotor development, a consultation with a geneticist is indicated.

Outpatient observation of preschool and primary school children with excess body weight can be carried out by both a pediatrician and a pediatric endocrinologist. Monthly visits are necessary during the first 3 months, then (with positive dynamics) – once every 6–12 months.

During outpatient observation of adolescents with obesity, a consultation with a pediatric endocrinologist is indicated. Screening for comorbid conditions is mandatory. Outpatient observation is carried out monthly in the first 3 months, then (with positive dynamics) – once every 6 months. Children with complicated obesity are observed by a pediatric endocrinologist once every 3–6 months.

If complications persist, the scope of examinations and observations by specialists is determined individually.

Clinical case of obesity in a child

A 16-year-old patient was admitted to the Penza Regional Children's Clinical Hospital named after N. F. Filatov on a planned basis in the cardiology department (fig. 4, 5). Complaints of pain in the heart area, headache, increased blood pressure up to 170 mmHg, nosebleed, poor tolerance of physical activity.

History of the disease. Within six months of higher education the complaints appeared. Is under the dispensary supervision of an allergist – bronchial asthma, atopic form, moderate-severe persistent course, not controlled. Allergic rhinitis, persistent course. Household and pollen (meadow grasses) sensitization. Increase in height per year +10 cm, in weight – +10 kg. Has been practicing karate for 3 years.

Life history. The child grew and developed according to his age. He was vaccinated according to the age. Not vaccinated against COVID-19, no pneumococcal vaccine. Heredity: paternal grandmother – hypertension, stroke at age 30; dad – hypertension. No injuries or surgeries. Past illnesses: acute respiratory viral infection, chickenpox, infectious mononucleosis.

Physical examination. Height – 185 cm, weight – 121 kg. Skin is clean, normal color, striae were found on the skin of the lower abdomen, hyperpigmentation on the back surface of the skin of the left shoulder. Subcutaneous fat layer is excessive. Increased nutrition.



Fig. 4. Clinical case, patient 16 years old (front view).



Fig. 5. Clinical case, patient 16 years old (side view).

Respiratory system: no dullness on percussion, pulmonary sound, no dyspnea, vesicular breathing, no wheezing. Respiratory rate is 18 per 1 min.

Cardiovascular system: apical impulse in the 5th intercostal space, localized, borders of cardiac dullness are expanded, heart sounds are muffled, heart rate (HR) is 87 beats/min, blood pressure is 125/82 mmHg, pulse is satisfactory. There is no peripheral edema.

The abdomen is soft and painless on palpation. The liver and spleen are not enlarged. Stool and urination are not affected. The thyroid gland is not enlarged and painless.

Results of echocardiography (Echo CG) from 05.17.2023:

slight dilation of the left ventricle (LV);

LV myocardial thickness at the upper limit of the adolescent norm;

LV systolic function is preserved;

additional LV chords.

Ambulatory blood pressure monitoring (ABPM) from 05/18/23:

persistent borderline systolic-diastolic arterial hypertension at night.

Complete blood count (CBC) from 05/17/23:

hemoglobin – 150 g/l;

erythrocytes – $5.8 \cdot 10^{12}/l$;

leukocytes – $9.2 \cdot 10^9/l$;
platelets – $253.0 \cdot 10^{12}/l$;
erythrocyte sedimentation rate – 3 mm/h.

General urine analysis (GUA):

color – light yellow;
transparent, relative density – 1015;
reaction pH = 6;
protein – 0.1 g/l.

Biochemical blood test:

LDL cholesterol – 1.99 mmol/l;
cholesterol – 2.29 mmol/l;
creatinine – 96 $\mu\text{mol}/l$;
glucose – 2.15 mmol/l;
HDL cholesterol – 0.89 mmol/l;
triglycerides – 0.87 mmol/l;
K – 4.70 mmol/l;
Na – 147.3 mmol/l;
Ca – 1.39 mmol.

Coprogram from 05/15/23: unformed, soft consistency, mild odor, no mucus detected, pH – 6.5, positive reaction to occult blood, no helminth eggs detected.

Electrocardiogram (ECG): sinus rhythm, sinus arrhythmia, horizontal position of the electrical axis of the heart.

The patient has simple (exogenous-constitutional) obesity of the III degree, SDS BMI +3.1. There is a hereditary predisposition, physical inactivity, and overnutrition. The reaction to occult blood is positive, since the day before there was a nosebleed against the background of increased blood pressure and blood was swallowed and entered the gastrointestinal tract.

Test control

1. Obesity is...

- a) a set of abnormalities such as obesity, hypertension, elevated levels of sugar and cholesterol in the blood, which significantly increase the risk of developing cardiovascular disease, type 2 diabetes and a number of other diseases;
- b) decreased sensitivity of insulin-dependent cells to the action insulin action with subsequent disruption of glucose metabolism and its entry into cells;
- c) a heterogeneous group of hereditary and acquired diseases disorders associated with excess accumulation of fatty tissue in the body;
- d) a type of connective tissue of animals formed from the mesenchyme and consisting of specialized cells that accumulate fats – adipocytes.

2. The most common type of obesity...

- a) constitutional-exogenous;
- b) hypothalamic;
- c) syndromic;
- d) monogenic.

3. Etiology of obesity...

- a) excess calorie intake in conditions of physical inactivity and investigative predisposition;
- b) neuroendocrine diseases (hypothyroidism);
- c) mutations of the genes of leptin, leptin receptor, melanoma receptors Cortina types 3 and 4;
- d) all of the above.

4. Causes of monogenic obesity include...

- a) mutations of the genes of leptin, leptin receptor, melanoma receptors types 3 and 4, proopiomelanocortin, proconvertase type 1;
- b) chromosomal abnormalities;
- c) long-term use of corticosteroids, antidepressants and others;
- d) the presence and treatment of tumors of the hypothalamus and brainstem, the therapy for brain tumors and hemoblastoses, head trauma or stroke.

5. Hypothalamic obesity is...

- a) obesity associated with excess caloric intake conditions of physical inactivity and hereditary predisposition;
- b) obesity associated with the presence of chromosomal abnormalities;
- c) obesity caused by long-term use of corticosteroids drugs, antidepressants and other medications;
- d) obesity associated with the presence and treatment of hypothalamic tumors and brainstem, radiation therapy for brain tumors and hematologic malignancies, head trauma or stroke.

6. Obesity associated with excess calorie intake in conditions of physical inactivity and hereditary predisposition is...

- a) hypothalamic;
- b) syndromic;
- c) constitutional-exogenous;
- d) monogenic.

7. Complications of obesity include...

- a) dyslipidemia;
- b) hyperandrogenism syndrome;
- c) disorders of the musculoskeletal system;
- d) all of the above.

8. SDS BMI 2.6–3.0 corresponds to...

- a) I degree of obesity;
- b) II degree of obesity;
- c) III degree of obesity;
- d) morbid obesity.

9. SDS BMI ≥ 4.0 corresponds to...

- a) I degree of obesity;
- b) I degree of obesity;
- c) III degree of obesity;
- d) morbid obesity.

10. SDS BMI 2.0–2.5 corresponds to...

- a) I degree of obesity;
- b) II degree of obesity;
- c) III degree of obesity;
- d) morbid obesity.

11. The next clinical picture: early onset of obesity disorders, rapid progression, often delayed neuropsychic development from moderate to severe, the presence of organ-specific developmental anomalies – are characteristic...

- a) for hypothalamic obesity;
- b) syndromic obesity;
- c) constitutional-exogenous obesity;
- d) monogenic obesity.

12. For craniopharyngiomas, a characteristic symptom is...

- a) precocious sexual development;
- b) slowdown in growth rates;
- c) anosmia;
- d) anesthesia.

13. A characteristic symptom of gliomas is...

- a) precocious sexual development;
- b) slowdown in growth rates;
- c) anosmia;
- d) anesthesia.

14. The development of monogenic obesity is caused by mutations of...

- a) Leptin cortin system;
- b) Leptin-melanocortin system;
- c) Hypothalamic-pituitary system;
- d) Hypothalamic-pituitary-adrenal system.

**15. Presence of striae, follicular keratosis, polyphagia, cher-
acanthosis nigricans, arterial hypertension...**

- a) always correlates with the degree of obesity;
- b) does not always correlate with the degree of obesity.

**16. The main risk factors for overweight and obesity Rhenium in
children is referred to...**

- a) insufficient duration and sleep disturbances;
- b) physical inactivity;
- c) the influence of education and family factors;
- d) all of the above.

17. Factors that program obesity include...

- a) overweight parents;
- b) disruption of carbohydrate metabolism during pregnancy (gestational diabetes);
- c) maternal smoking during pregnancy;
- d) all of the above.

18. Decreased sleep duration in infants age leads to an increase in concentration of...

- a) leptin;
- b) ghrelin;
- c) thyroliberin;
- d) glucagon.

19. Leptin is secreted by...

- a) hypothalamus;
- b) the pituitary gland;
- c) adipocytes;
- d) kidneys.

20. Under the influence of the enzyme KP1 of the POMC are formed...

- a) ACTH;
- b) α -MSH;
- c) all of the above;
- d) none of the above.

21. Saturation signaling occurs through activation MC4R receptors of...

- a) arcuate nucleus;
- b) paraventricular nucleus;
- c) ventromedial nucleus;
- d) mammillary nucleus.

22. Peptides with an orexigenic effect include...

- a) glucagon;
- b) cholecystokinin;
- c) leptin;
- d) ghrelin.

23. Peptides with anorexigenic effect include...

- a) serotonin;
- b) neuropeptide Y;
- c) somatoliberin;
- d) somatostatin.

24. Hypothyroidism leads to...

- a) a decrease in the intensity of lipolysis;
- b) increasing the intensity of lipolysis;
- c) increasing the intensity of lipogenesis;
- d) none of the above.

25. Absolute or relative leptin deficiency...

- a) leads to increased appetite;
- b) leads to a decrease in appetite;
- c) does not affect appetite.

26. Overweight in children and adolescents from 0 to 19 years old should be defined as a BMI equal to...

- a) +1.0...+2.0 SDS BMI;
- b) +2.0 SDS BMI;
- c) ± 1.0 SDS BMI;
- d) -2.0 SDS BMI.

27. Obesity in children and adolescents aged 0 to 19 years should be determined share as BMI equal to or greater than...

- a) +1.0...+2.0 SDS BMI;
- b) +2.0 SDS BMI;
- c) ± 1.0 SDS BMI;
- d) -2.0 SDS BMI.

28. The presence of abdominal obesity is indicated by excess waist circumference greater than percentile...

- a) 80th;
- b) 70th;
- c) 90th;
- d) 95th.

29. If the following indicators are present in a female child: cholesterol = 4.2 mmol/l, LDL = 1.7 mmol/l, HDL = 1.1 mmol/l...

- a) a diagnosis of dyslipidemia can be made;
- b) a diagnosis of dyslipidemia cannot be made.

30. If the following indicators are present in a male child: cholesterol = 5.3 mmol/l, LDL = 3.1 mmol/l, HDL = 0.9 mmol/l...

- a) a diagnosis of dyslipidemia can be made;
- b) a diagnosis of dyslipidemia cannot be made.

31. Children and adolescents with obesity in clinical cases of obstructive sleep apnea syndrome, it is necessary to carry out...

- a) ABPM;
- b) nocturnal polysomnography;
- c) ECG;
- d) FGDS.

32. In the presence of hypothalamic obesity it is necessary to perform...

- a) molecular genetic research;
- b) MRI of the brain;
- c) determination of ALT;
- d) ABPM.

33. Treatment of overweight and obesity includes...

- a) expansion of physical activity;
- b) diet therapy;
- c) correction of eating behavior;
- d) all of the above.

34. A necessary condition for effective treatment is...

- a) limiting sweet fruits to 1 serving (100 g) per day;
- b) two meals a day;
- c) excluding breakfast;
- d) reducing the amount of fresh vegetables and whole grain products.

35. For children and adolescents from 6 to 17 years old with obesity and overweight, daily physical activity of at least... is recommended.

- a) 120 min;
- b) 80 min;

- c) 60 min;
- d) 180 min.

36. For children aged 1 to 4 years for prevention of overweight and obesity, various types of physical activity of any intensity of at least... are recommended.

- a) 120 minutes per day;
- b) 180 minutes per day;
- c) 199 minutes per day;
- d) 130 minutes per day.

37. For children and adolescents with obesity and overweight in order to prevent physical inactivity, it is recommended to reduce the amount of inactive time spent in front of a TV screen, computer monitor...

- a) up to 2 hours per day or less;
- b) 4 hours per day or less;
- c) 3 hours per day or less;
- d) 5 hours a day or less.

38. Use of pharmacotherapy (in combination with changes in (lifestyle changes)) in children and adolescents with obesity, it is recommended...

- a) from the age of 12;
- b) from the age of 10;
- c) from the age of 15;
- d) from the age of 18.

39. Use of pharmacotherapy (in combination with changes in lifestyle) in children and adolescents with obesity, it is recommended in case of ineffectiveness of measures aimed at forming a healthy lifestyle, the duration of which was not less than...

- a) 6 months;
- b) 9 months;
- c) 1 year;
- d) 1.5 years.

40. ... is used for pharmacotherapy of obesity.

- a) orlistat;
- b) valsartan;

- c) metformin;
- d) loperamide.

41. The starting dose of liraglutide is...

- a) 0.6 mg per day;
- b) 0.4 mg per day;
- c) 3 mg per day;
- d) 1.5 mg per day.

42. The dose of liraglutide should be increased until the value will be...

- a) 0.6 mg;
- b) 3.0 mg; 1.2 mg;
- c) 2 mg.

43. Liraglutide is administered...

- a) intramuscularly;
- b) subcutaneously;
- c) intravenously;
- d) orally.

44. The maximum daily dose of orlistat is...

- a) 390 mg;
- b) 360 mg;
- c) 320 mg;
- d) 300 mg.

45. Condition for using surgical treatment method obesity is...

- a) BMI >35 kg/m² in combination with severe complications (non-alcohol-steatohepatitis, type 2 diabetes mellitus, obstructive sleep apnea syndrome);
- b) documented ineffectiveness of conservative methods of treating obesity for 12 months in specialized centers;
- c) absence of mental illness and eating disorders behavior (including those caused by the presence of syndromic and hypothalamic forms of obesity);
- d) all of the above.

46. With BMI>40 kg/m² (SDS BMI>4.0 for a given gender and age) for surgical treatment...

- a) the presence of complications of obesity must be taken into account;
- b) there is no need to take into account the presence of complications of obesity.

47. Bariatric surgeries are divided into...

- a) restrictive (gastro-restrictive) groups;
- b) malabsorptive (shunting) groups;
- c) combined groups;
- d) all of the above.

48. Restrictive operations are aimed at...

- a) reducing the volume of the intestine;
- b) reduction of stomach volume;
- c) reduction of adipose tissue;
- d) resection of the pancreas.

49. Children under one year of age are observed by a pediatrician...

- a) once every 3 months;
- b) monthly;
- c) once every 6 months;
- d) weekly.

50. Children with complicated obesity are observed in children's endocrinologist...

- a) once every 3–6 months;
- b) once a year;
- c) once a month;
- d) 2 times a month.

Clinical tasks

Task 1

A 13-year-old boy was referred to the Regional Children's Clinical Hospital for examination with complaints of excess weight, frequent headaches, dizziness, and fatigue. According to his mother, the boy began to gain weight at the age of 7, but over the past 1.5 years, a particularly large increase in weight has been noted. Headaches and dizziness have been bothering him for a year.

From the family history it is known that the boy's mother, father, and maternal grandmother are overweight. The child's mother has high blood pressure, and the grandmother has type 2 diabetes. The family's diet is dominated by flour products, pasta, potatoes, and often baked goods.

Objectively: the child's height is 171 cm, weight is 92 kg. Excessive uneven deposition of subcutaneous fat, mainly on the chest and abdomen. Folliculitis. There are bright purple-bluish striae on the skin of the chest and abdomen. Heart sounds are muffled. Heart rate is 80 beats per minute. Blood pressure is 135/80 mmHg. The abdomen is soft and painless. The liver is not enlarged. The stool is formed and regular. The isthmus of the thyroid gland is palpable. The external genitalia are formed according to the male type.

1. Make the most probable diagnosis.
2. Make a survey plan.
3. Create a treatment plan.

Task 2

A 10-year-old female patient was admitted to the Regional Children's Clinical Hospital with complaints of increased appetite, excess weight, fatigue, weakness, sweating, and dizziness.

Anamnesis of life. Girl from the third pregnancy, first term birth.

Born full-term with a body weight of 3500 g, height 52 cm. Started crying immediately, was put to the breast after 12 hours. Breastfed until 1 year. Grew and developed according to age. Past illnesses include pneumonia at age 7, otitis at age 10. The girl has a family history of this disease.

Medical history. The patient considers herself to be over 5 years old when she began to gain weight excessively. Over the last year, she has gained 10 kg. According to her parents, the girl loves flour products and sweets.

Does not follow a diet (appetite is especially increased in the second half of the day). Does not engage in sports or physical education.

Objectively. Height 146 cm, weight 69 kg. Skin is clear, pale. Bright blush of cheeks is noted. Subcutaneous fat layer is excessively developed, distributed evenly according to the female type.

Auscultatory. Vesicular breathing in the lungs. Heart sounds are somewhat muffled, rhythmic. Heart rate is 80 beats/min, with satisfactory filling and tension. Blood pressure is 120/75 mmHg. The abdomen is soft and painless.

Laboratory data. Blood sugar – 4.5 mmol/l; GTT: fasting blood sugar – 4.8 mmol/l; after 60 min – 6.3 mmol/l; after 120 min – 8.7 mmol/l.

Biochemical blood test: total protein – 71 g/l, albumins – 58 %, α -globulins – 12 %, γ -globulins – 14 %, β -globulins – 16 %, cholesterol – 8.5 mmol/l, β -lipoproteins – 42 units.

1. Identify the leading syndromes.
2. Make a clinical diagnosis.
3. Make a plan for additional examination.
4. Prescribe treatment.

Standard answers to the test tasks

1 – c	11 – b	21 – b	31 – b	41 – a
2 – a	12 – b	22 – d	32 – b	42 – b
3 – d	13 – a	23 – a	33 – d	43 – b
4 – a	14 – b	24 – a	34 – a	44 – b
5 – d	15 – b	25 – a	35 – c	45 – d
6 – c	16 – d	26 – b	36 – b	46 – b
7 – d	17 – d	27 – a	37 – a	47 – d
8 – b	18 – b	28 – c	38 – a	48 – b
9 – d	19 – c	29 – b	39 – c	49 – b
10 – a	20 – c	30 – a	40 – a	50 – a

Standard answers to the problems

Task 1

1. *Diagnosis*: exogenous-constitutional obesity II–III stage-penalties, SDS BMI +3.2, complicated form: arterial hypertension.

2. *Survey plan*:

- OAK;
- OAM;
- GTT;
- biochemical blood test (cholesterol, TG, bilirubin, AST, ALT, K, Na, Ca, P, alkaline phosphatase (ALP), creatinine, urea, protein, albumin);
- thyroid stimulating hormone (TSH), free T4, cortisol, ACTH, insulin similar factor-1, somatotrophic hormone, aldosterone, plasma renin activity, content of metanephrines and normetanephrines in daily urine;
- ultrasound of the abdominal cavity, adrenal glands, thyroid gland;
- ECG;
- Echo CG;
- ABPM;
- consultation with a neurologist;
- consultation with a cardiologist;
- consultation with a physiotherapist;
- consultation with a nutritionist;
- consultation with an ophthalmologist (fundus).

3. *Treatment plan*:

- 1) diet (table No. 8);
- 2) daily physical activity;
- 3) drug therapy:
 - lipoic acid 0.025×3 times a day;
 - capoten for blood pressure over 130/80 mmHg – 25 mg;
 - orlistat 1 capsule $\times 3$ times a day before main meals food.

Task 2

1. *Leading syndrome*: overweight.

2. *Clinical diagnosis*: exogenous-constitutional obesity III degree, SDS BMI +3.7, complicated form: dyslipidemia. Impaired glucose tolerance.

3. *Survey plan*:

- OAK;
- OAM;
- GTT + insulin (insulin resistance indices);

- biochemical blood test (bilirubin, AST, ALT, K, Na, Ca, P, alkaline phosphatase, creatinine, urea);
- TSH, fT4, cortisol, C-peptide, HbA1C;
- Ultrasound of the abdominal cavity, adrenal glands, thyroid gland;
- ECG;
- Echo CG;
- ABPM;
- consultation with a neurologist;
- consultation with a physiotherapist;
- consultation with a nutritionist;
- consultation with an ophthalmologist.

4. *Treatment plan:*

- diet (table No. 8);
- daily physical activity;
- drug therapy: lipoic acid 0.025×2 times a day.

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Учебное издание

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На английском языке

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Подписано в печать 05.05.2025.
Формат 60×84¹/₁₆. Усл. печ. л. 2,09.
Тираж 106. Заказ № 151.

Издательство ПГУ.
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