Kazan Federal University

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HYGIENIC REQUIREMENTS TO CONSTRUCTING A RATIONAL NUTRITION. METHODS OF DETERMINING THE BODY'S NEEDS FOR ENERGY AND NUTRIENTS

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The teaching aid has been compiled in accordance with the requirements of the Federal State Educational Standard and the programs of the disciplines "Hygiene" for students studying in the following areas of training/specialty: 31.05.01 - General Medicine; 33.05.01 - Pharmacy; 30.05.01 - Medical Biochemistry; 31.05.03 - Dentistry in order to study the hygienic requirements for the construction of rational nutrition and methods for determining the body's need for energy and nutrients. The manual includes theoretical questions to consolidate the lecture course, practical classes, and test assignments for student self-control.

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Topic 1. Hygienic requirements for rational nutrition

1. Relevance of the topic, objectives, content of the lesson

Nutrition is one of the most important factors in human life. Nutrition has a huge impact on the state of the central nervous system and through it on all functions of the body. Various diets through digestion processes have a pharmacological effect on physiological and pathological processes in the body.

Rational nutrition ensures proper growth and development of the body, compensates for all energy and plastic costs, increases the body's resistance to harmful effects of the external environment, promotes the development of functional capabilities and increases the intensity of labor.

Normal life activity of the body is possible provided that it is supplied with an adequate amount of energy. Energy sources are nutrients (proteins, fats, carbohydrates) that enter the body with food. In addition, food products contain vitamins, minerals, water, organic acids, dietary fiber, tannins and other components. Although not sources of energy, they are necessary for metabolic processes in the body.

Scientific achievements in biological chemistry, physiology, nutritional hygiene, and vitaminology have made it possible to establish and scientifically substantiate the physiological needs of humans for food substances (nutrients) depending on age, gender, and profession.

Objective of the lesson

Calculate and evaluate the daily energy expenditure of the body depending on gender, age, and the nature of work activity.

The student must:

- to know:

Методы определения суточных энергетических затрат организма

- to be able:

1. Determine ideal body weight

2. Calculate total energy expenditure per day using the chronometric-table method

3. Determine the required energy value of the daily food ration

4. Calculate the physiological need of the body for essential nutrients

5. Evaluate the results obtained, give recommendations

Questions for self-control

1. What values does daily energy expenditure consist of?

2. Methods for determining daily energy expenditure.

3. What do daily energy expenditures depend on?

4. Methods for determining ideal body weight.

5. The concept of «specific dynamic action of food».

Contents of the lesson

1. Determine the ideal body weight (Appendix 1, Cooper formula)

2. Calculate the body's daily energy requirement:

a) calculate the basal metabolic rate (Appendix 2)

b) calculate the energy expenditure for the specific dynamic action of food (10 % of the basal metabolic rate),

c) create a daily chronogram (Appendix 3)

d) calculate the total energy expenditure for various activities according to the daily chronogram (this includes the basal metabolic rate),

e) calculate the unaccounted energy expenditure (5 % of the energy expenditure for various activities),

f) calculate the total energy expenditure (summation of c, b, e).

3. Determine the daily requirement for essential nutrients

4. Provide a conclusion, recommendations.

2. Terms and definitions

Adequate consumption level is the level of daily consumption of food and biologically active substances established on the basis of calculated or experimentally determined values or estimates of the consumption of food and biologically active substances by a group/groups of practically healthy people. Adequate consumption levels are established for food and biologically active substances for which their essentiality has not yet been

confirmed, but there is sufficient scientific evidence characterizing their role as exogenous regulators of metabolism.

Antagonism is the suppression of the vital activity of one microbial population by another due to the ability to release substances (antibiotics, bacteriocins, organic and fatty acids) into the microbial ecosystem habitat, causing a delay in reproduction or death of its component(s).

Proteins are high-molecular nitrogen-containing organic compounds consisting of alpha-amino acids linked into a molecular chain by a peptide bond, performing plastic, energetic, catalytic, hormonal, regulatory, protective, transport and other functions.

Basal metabolic rate (BMR) is the minimum amount of energy required to carry out vital processes, i.e. energy expenditure on all physiological and biochemical processes, functioning of organs and systems of the body in a state of temperature comfort (20 ºC), complete physical and mental rest on an empty stomach.

Vitamins are a group of irreplaceable (essential) nutrients, which are low-molecular organic compounds of various chemical natures, absolutely necessary for the implementation of metabolism, growth processes and biochemical support of vital functions of the body**.**

Glycemic index of food products (GI) is a relative indicator characterizing the ability of food products, due to the carbohydrates they contain, to increase the level of glucose in human blood after consumption (postprandial glycemic effect). The GI of individual food products is assessed by their carbohydrate content on a scale from 0 to 100 (for pure sucrose) and is calculated based on how much the blood glucose level increases in 2 hours after consuming 50 grams of carbohydrates of a certain product compared to 50 grams of glucose.

Added sugars are all mono- and disaccharides added to food products and beverages during production, preparation and direct consumption, including table sugar and sugars from honey, syrups, fruit and vegetable juices and their concentrates.

Fats (lipids) are esters of glycerol and higher fatty carboxylic acids. They are a plastic material and an essential source of energy, participate in nervous and hormonal regulation.

Critically important nutrients are nutrients, the increased content of which in food products and diets increases the risk of occurrence and development of diseases of alimentary origin. Critically important nutrients for public health include table salt, added sugars, fats, including fats containing saturated fatty and/or trans-isomeric fatty acids.

Macronutrients are the main food substances (proteins, fats and carbohydrates) that provide the plastic, energy and other needs of the body, necessary for a person in quantities measured in grams.

Micronutrients are food substances (vitamins, minerals, including macro- and microelements) that are contained in food in very small quantities – milligrams or micrograms. They are not sources of energy, but participate in the processes of food absorption, regulation of functions, implementation of growth processes, adaptation and development of the body.

Minor biologically active substances of food are natural substances with an established chemical structure and physiological effect, present in food in small quantities (milligrams or micrograms) and playing a proven role in maintaining health, performing the functions of exogenous regulators of metabolism.

Mono- and disaccharides are simple carbohydrates that are polyhydric aldehyde or keto alcohols. Simple carbohydrates in the form of mono- (fructose, glucose) and disaccharides (sucrose, lactose, maltose, etc.) are naturally present in food products and can also be added during production, preparation, and/or direct consumption.

Saturated fatty acids are aliphatic monobasic carboxylic acids with an open unbranched chain containing carbon atoms linked by single bonds. At high levels of consumption, they are risk factors for the development of non-infectious alimentary-dependent diseases, including obesity, atherosclerosis, etc.

Essential nutrients are nutrients that are not formed in the human body and must be supplied with food to ensure its vital functions. Their deficiency in nutrition leads to the development of pathological conditions. Standards of physiological needs for energy and nutrients are the average value of the required intake of food and biologically active substances, ensuring the optimal implementation of physiological and biochemical processes fixed in the human genotype.

Optimal ratio of shares (specific weight) of macronutrients in the structure of the energy value of the diet is the ratio of the main nutrients as a percentage of the caloric content of the diet, capable of providing the human body with the necessary amount of proteins, fats and carbohydrates, maintaining energy balance and human health.

Table salt is salt, which is sodium chloride.

Dietary fiber is high-molecular carbohydrates, mainly of plant origin (cellulose, pectins and others, including some amylase-resistant types of starches), and associated plant substances (lignin), resistant to digestion and adsorption in the small intestine of a person, completely or partially fermented in the large intestine. Natural (own) sugars are mono- and disaccharides naturally present in unprocessed fruits and vegetables, as well as milk.

Trans fatty acid isomers are spatial isomers of monounsaturated and polyunsaturated fatty acids that have unconjugated carbon-carbon double bonds separated by at least one methylene group in the trans configuration.

Carbohydrates are polyatomic aldehyde and keto alcohols, simple (mono- and disaccharides) – sugars and complex (oligosaccharides, polysaccharides) – glycans, which are the main sources of energy for humans.

Physiological need for energy and nutrients is a necessary set of qualitative and quantitative essential alimentary factors to maintain a dynamic balance between humans as a biological species formed in the process of evolution and the environment, aimed at ensuring life, preservation and reproduction of the species and maintaining adaptive potential.

Phospholipids are esters of polyhydric alcohols (glycerol, sphingosine) and higher fatty acids containing a phosphoric acid residue linked to a nitrogenous base or another group of atoms of various chemical natures (choline, ethanolamine, amino acid residues, carbohydrate fragments); they constitute the main class of membrane lipids.

Energy balance is an equilibrium state between the energy supplied with food and its expenditure on all types of physical activity, on maintaining basal metabolism, growth, development, and additional expenditure in women during pregnancy and breastfeeding.

Daily energy expenditure is the sum of all energy expenditure by the body during the day, including basal metabolism, physical activity, specific dynamic action of food (food thermogenesis), cold thermogenesis (maintaining body temperature), growth and formation of tissues in children, as well as the fetus in pregnant women, and milk production in breastfeeding women.

3. Differentiation of population groups of the Russian Federation

3.1. Age and sex groups of the population

The following age and sex groups for adults are identified:

men and women 18–29 years old, 30–44 years old, 45–64 years old, 65–74 years old, 75 years old and older.

The age classification of the child population adopted in the Russian Federation was developed taking into account two factors: biological (ontogenetic) and social criteria, taking into account the peculiarities of education and upbringing in the Russian Federation (Table 1).

Table 1

Age division of the child population

1. Early age • infancy • preschool	 · 0–11 months* · 1–2 years
2. Preschool age	• 3–6 years

Continued of Table 1

3. School** age • junior • middle • senior	 · 7–10 years · 11–14 years · 15–17 years

Note:

* Here and below, for children and adults, the year is counted in full, including the months and days before the onset of the next (e.g., 11 months 29 days, 2 years 11 months 29 days).

** Includes children aged 7 to 17 years (inclusive), regardless of the form of education or professional activity.

The choice of these age ranges is determined by the need to reflect the physiological characteristics of the body, including constant changes in growth rate, body composition, physical activity and nutritional status.

3.2. Characteristics of physical development of the population

Anthropometric indicators characterizing physical development (body size) are the main component of assessing a person's nutritional status and the main determining factor in assessing absolute energy and protein needs. To assess the energy and nutrient needs of a person or group of people, data on certain anthropometric parameters of men and women of different age groups are required. The basic indicators of physical development are a person's height and body weight (BW).

The presence of a deficiency or excess body weight and the degree of obesity in adults are assessed based on the calculation of the body mass index (BMI) and its comparison with the WHO classification (Table 2).

The body mass index (BMI or Quetelet index 2) is expressed in kg/m2 and calculated using the formula:

$$BMI = \frac{body\ weight}{height\ 2}. \quad (1)$$

Waist circumference (WC) is an indicator of the degree of fat deposition in the abdominal area in humans. WC is measured in a standing posi-

tion on the axillary line between the lower edge of the lower rib and the upper point of the iliac crest of the pelvic bone. Normally, this indicator should not exceed 94 cm for men and 80 cm for women. With abdominal obesity (apple-shaped figure), WC is more than 102 cm for men and 88 cm for women, while the risk of developing type 2 diabetes and cardiovascular diseases increases.

Table 2

BMI and nutritional status for adults

BMI, kg/m²	Nutritional status
less 18,5	Underweight
18,5–24,9	Normal body weight
25,0–29,9	Overweight
30,0–34,9	Obesity grade 1
35,0–39,9	Obesity grade 2
Over 40	Obesity grade 3

The second important indicator (index) is the waist-to-hip ratio (WHR = WC/HR). Hip circumference (HR) is measured at the level of the most protruding points of the buttocks in a standing position. Normally, the WHR indicator is 0.85 for men, from 0.65 to 0.85 for women and is an indicator of normal fat distribution. If the WC/OB ratio is more than 0.85 in women and more than 1.0 in men, this indicates abdominal («upper type») obesity, which has an adverse effect on the cardiovascular system. It is fundamentally important that an increase in the IBI above the norm (with normal BMI values) may indicate a risk of developing alimentary-dependent diseases.

Anthropometric indicators, the presence of deficiency or excess body weight in children are assessed according to the WHO Child Growth Standards. They take into account the child's height, weight, gender and age.

Table 3

BMI and nutritional status for children

Age	0–5 years	5–17 years*
Risk of being overweight	BMI /age > 1SD to 2SD	–
Overweight	BMI /age > 2SD to 3SD	BMI /age > 1SD
Obesity	BMI by age > 3SD	BMI /age > 2SD
Mild underweight	BMI /age / body weight / height < - 1SD to - 2SD	BMI /age < - 1SD to - 2SD
Moderate underweight	body weight /age / body weight / height < - 2SD to - 3SD	BMI /age < - 2SD to - 3SD
Severe underweight	body weight /age / body weight / height < - 3SD	BMI /age < - 3SD

Note:

* For the purposes of this MR, the criteria for assessing anthropometric indicators are given for the age group up to 18 years.

To calculate the physiological energy requirement for men and women of different age groups, the average anthropometric characteristics (body weight and height) of the adult population with normal body weight (Table 4) were used, obtained on the basis of data from representative anthropometric studies within the framework of a selective observation of the diet of the population of the Russian Federation in 2018.

Anthropometric indicators, the presence of deficiency or excess body weight in children are assessed according to the WHO Child Growth Standards. They take into account the child's height, weight, gender and age.

The evaluation criteria include Z-score indicators, presented as standard (sigma) deviations (SDS - standard deviation score) (Table 3), by which the studied indicator differs from the median of the WHO Child Growth Standards: Z-score of body mass index for age, Z-score of body weight for age, Z-score of body length for age, Z-score of body weight for height. In a standard population, the median Z-score is 0.

Table 4

Anthropometric parameters of an adult with normal body weight*

Age	Men		Women	
	Body weight, kg	Height, cm	Body weight, kg	Height, cm
18–29	72,1	177,5	60,8	165,4
30–44	72,3	176,7	61,6	165,0
45–64	70,9	174,6	61,9	163,7
65–74	68,9	172,1	60,7	161,6
≥ 75	66,7	169,6	58,3	158,8

***Note**:*

* The calculation uses anthropometric data from individuals with normal body weight (BMI 20–25 kg/m²).

To determine the ideal body weight, use the formula of K. Cooper:

For men: $Body\ weight = \frac{Height\ (cm) \cdot 4}{2{,}54} - 128 \cdot 0{,}453;$ (2)

For women: $Body\ weight = \frac{Height\ (cm) \cdot 3{,}5}{2{,}54} - 108 \cdot 0{,}453.$ (3)

3.3. Population groups differentiated by level of physical activity

Group I (very low physical activity; men and women) – workers primarily engaged in mental labor, CFA – 1.4 (civil servants of administrative bodies and institutions, researchers, university and college teachers, secondary school teachers, students, medical specialists, psychologists, dispatchers, operators, including computer maintenance technicians and computer support, programmers, employees of financial and economic, legal and administrative services, employees of design bureaus and departments, advertising and information services, architects and engineers for industrial and civil construction, tax officials, museum employees, archives, librarians, insurance specialists, dealers, brokers, sales and purchasing agents, social and pension security employees, patent experts, designers, travel agency employees, information services and other related activities).

Group II (low physical activity; men and women) – workers engaged in light work, CFA – 1.6 (drivers of public transport, workers in the food, textile, clothing, radio-electronic industries, conveyor operators, weighers, packers, railway drivers, district doctors, surgeons, nurses, salespeople, employees of public catering establishments, hairdressers, employees of housing and maintenance services, restorers of art works, guides, photographers, technicians and operators of radio and television broadcasting, customs inspectors, employees of the police and patrol service and other related types of activities).

Group III (moderate physical activity; men and women) – workers engaged in medium-heavy work, CFA – 1.9 (fitters, adjusters, machine operators, drillers, drivers of electric cars, excavators, bulldozers and other heavy equipment, greenhouse workers, crop growers, gardeners, workers in the fish industry and other related types of activities).

Group IV (high physical activity; men and women) – workers engaged in heavy physical labor, CFA – 2.2 (construction workers, loaders, workers servicing railway tracks and repairing highways, workers in for-

estry, hunting and agriculture, woodworkers, metallurgists, blast furnace operators and foundry workers and other related activities).

4. Standardized indicators

4.1. Energy

Energy requirement is the level of energy consumed with food that ensures energy balance, while the body size, its composition and the level of physical activity of the individual correspond to a stable state of health and ensure the maintenance of economically necessary and socially desirable physical activity. Energy requirement of children, pregnant and lactating women also includes additional needs associated with tissue formation or milk secretion at a level that ensures normal life activity.

Daily energy expenditure is defined as the sum of energy expenditure on specific types of activity, each of which is calculated as the product of the basal metabolic rate (BM) by the corresponding physical activity coefficient and the time during which these types of activity are performed. In women, BM is 15 % lower than in men.

Table 5

Average values of the basal metabolic rate of the adult population of the Russian Federation (kcal/day)*

Age, years	BM, kcal/day	
	Men	Women
18—29	1692—1746	1337—1392
30—44	1615—1684	1269—1338
45—64	1490—1583	1166—1259
65—74	1405—1449	1091—1136
≥75	1362 and less	1045 and less

Note: * BMI 20–25 kg/m2.

To determine the physiological energy requirement, the basal metabolic rate values were calculated for each age and sex group of the popula-

tion (Table 5) based on the anthropometric parameters of a standard adult (Table 4) using the Mifflin-San Jeor formula:

$$Men\ BM\ (day) = 9{,}99\ \times\ body\ weight\ (kg) + 6{,}25 \times \text{height (cm)} - 4{,}92 \times age\ (years)\ + 5;\ (4)$$

$$Women\ BM\ (day) = 9{,}99\ \times\ body\ weight\ (kg) + 6{,}25 \times \text{height (cm)} - 4{,}92 \times age\ (years)\ - 161.\ (5)$$

Table 6

Schofield's formulas for calculating the value of basal metabolism by body weight in children

Age and gender	Formula	Standard error of calculation
Up to 3 years		
Boys	BM (MJ/day) = 0,249 × body weight * – 0,127	0,293
Girls	BM (MJ/day) = 0,244 × body weight – 0,130	0,246
Boys	BM (kcal/day) = 59,5 × body weight – 30,4	70
Girls	BM (kcal/day) = 58,3 × body weight – 31,1	59
3—10 years		
Boys	BM (MJ/day) = 0,095 × body weight + 2,110	0,280
Girls	BM (MJ/day) = 0,085 × body weight + 2,033	0,292
Boys	BM (kcal/day) = 22,7 × body weight + 504,3	67
Girls	BM (kcal/day) = 20,3 × body weight + 485,9	70
10—17 years **		
Boys	BM (MJ/day) = 0,074 × body weight + 2,754	0,440
Girls	BM (MJ/day) =0,056 × body weight + 2,898	0,466
Boys	BM (kcal/day) =17,7 × body weight + 658,2	105
Girls	BM (kcal/day) =13,4 × body weight + 692,6	111

Note:

* BM – body weight in kg.

** For the purposes of these MR, the formulas are given for the age group up to 18 years.

In children, the ratio of BW to body weight gradually decreases with age until puberty. The maximum energy requirement in adolescence is due to rapid growth. In the neonatal period, 35 % of the energy consumed with food is spent on growth, by the age of one year it decreases to 3 %, and during periods of growth spurts it increases to 4 %.

Physiological energy requirements for children are 110–115 kcal/kg of body weight for children up to 1 year old and from 1300 to 2900 kcal/day (with increasing age) for children over 1 year old with an adequate level of physical activity.

Physiological energy requirements for adults are from 2150 to 3800 kcal/day for men and from 1700 to 3000 kcal/day for women. During pregnancy and breastfeeding, energy requirements increase by an average of 15 and 20 %, respectively. Energy expenditure on adaptation to a cold climate in the Far North increases by an average of 15 %. To calculate the BMR in children, the Schofield equations are used, taking into account the child's gender and age (Table 6).

4.2. Food and biologically active substances

4.2.1. Macronutrients

Proteins

Proteins are high-molecular nitrogen compounds, the molecules of which are built from amino acid residues. Proteins play an important role in the body, performing plastic, energetic, catalytic (enzymes), regulatory (hormones), protective (immunoglobulin, interferon), transport (hemoglobin, myoglobin, etc.) and other functions.

The need for protein is an evolutionarily developed dominant in human nutrition, due to the need to ensure an optimal physiological level of essential amino acids. With a positive nitrogen balance during periods of

growth and development of the body, as well as during intensive reparative processes, the need for protein per unit of body weight is higher than that of an adult healthy person.

The quality of protein is determined by the presence in it of a complete set of essential amino acids in a certain ratio both among themselves and with replaceable amino acids. Biological value of protein is an indicator of protein quality, characterizing the degree of nitrogen retention and the efficiency of its utilization for the growing body of children or for maintaining nitrogen balance in adults.

Protein digestibility is an indicator characterizing the proportion of nitrogen absorbed in the body from the total amount consumed with food.

The physiological need for protein for adults is 12–14 % of the daily energy requirement: from 75 to 114 g / day for men and from 60 to 90 g / day for women.

Physiological needs for protein for children under 1 year old are 2.2–2.9 g / kg of body weight, children over 1 year old (with increasing age) from 39 to 87 g / day.

Protein of animal origin. The closest to the ideal protein and containing a full set of essential amino acids in quantities sufficient for protein biosynthesis in the human body are proteins from animal products (milk and dairy products, meat and meat products, fish and fish products, seafood, eggs). Alternative sources are insects, microorganisms, cell cultures («artificial meat», etc.).

Proteins of animal origin are absorbed by the body by 93–96 %.

For adults, the recommended proportion of animal proteins in the daily diet from their total amount is 50 %. For children, the recommended proportion of animal proteins in the daily diet is 60–70 %.

Protein of plant origin. Proteins of plant origin (cereals, legumes, nuts, mushrooms, vegetables, fruits, alternative sources – microalgae, etc.) have a deficiency of one or more essential amino acids.

Legumes contain an average of 5–24 % protein, but they contain proteinase inhibitors, which reduces its absorption. At the same time, the ami-

no acid composition and absorption of isolates and concentrates of legume proteins are close to proteins of animal origin.

Protein from plant products is absorbed by the body by 62–80 %. Protein from higher fungi is absorbed at a level of 20–40 %.

Fats

Fats (lipids) are part of cells and perform two main functions: structural components of biological membranes and reserve energy material.

Fat synthesized by the body and supplied with food can be deposited in adipose tissue, and then used as needed to cover the energy and plastic needs of the body.

Fats of plant and animal origin have different fatty acid compositions, which determine their physical properties and physiological and biochemical effects.

Fats serve as a source of essential nutrients – fat-soluble vitamins and essential fatty acids. Fatty acids are divided into two main classes – saturated and unsaturated (mono- and polyunsaturated).

Fat consumption for adults should be no more than 30 % of the caloric content of the daily diet. The physiological need for fats is from 72 to 127 g / day for men and from 57 to 100 for women. The physiological need for fats for children under one year is 5.5–6.5 g/kg of body weight, for children over one year – from 44 to 97 g/day.

Saturated fatty acids (SFA) are monobasic fatty acids that do not have double or triple bonds between adjacent carbon atoms, i.e. all bonds are only single.

Medium chain fatty acids (C8 – C14) can be absorbed in the digestive tract without the participation of bile acids and pancreatic lipase, are not deposited in the liver and undergo β-oxidation.

High consumption of saturated fatty acids increases blood cholesterol levels and is a risk factor for the development of type 2 diabetes, obesity, cardiovascular and other diseases. At the same time, saturated fatty acids

are involved in the body's thermoregulation, have a positive effect on the functioning of internal organs, etc.

The consumption of saturated fatty acids for adults and children should be no more than 10 % of the daily caloric intake.

Monounsaturated fatty acids (MUFA) are fatty acids whose molecules have a single double bond between adjacent carbon atoms. Monounsaturated fatty acids include myristoleic and palmitoleic acids (found in significant quantities in the fats of fish and marine mammals), oleic acid (one of the main fatty acids in olive, safflower, sesame, and rapeseed oils). MUFA, in addition to their intake with food, are synthesized in the human body from saturated fatty acids and partly from carbohydrates. The physiological need for monounsaturated fatty acids for adults is 10 % of the daily caloric intake.

Polyunsaturated fatty acids (PUFA) are fatty acids with two or more double and/or triple bonds between carbon atoms.

Of particular importance for the human body are such essential PUFAs as linoleic and linolenic, which are structural elements of cell membranes and ensure normal development and adaptation of the human body to unfavorable environmental factors. The physiological need for PUFAs for adults is 6–10 % of the daily caloric intake. The physiological need for PUFAs for children is 5–10 % of the daily caloric intake.

Omega-6 (ω-6) and Omega-3 (ω-3) PUFAs. The two main groups of PUFAs are the ω-6 and ω-3 family acids. ω-6 fatty acids are found in almost all vegetable oils and nuts; ω-3 fatty acids are also found in a number of oils (flaxseed, cruciferous seed, soybean). The main dietary source of ω-3 fatty acids are fatty fish and some seafood. Of the ω-6 PUFAs, linoleic acid occupies a special place, which is the precursor of the most physiologically active acid of this family – arachidonic acid.

The physiological requirement for adults is 5-8 % of the daily caloric intake for ω-6 and 1-2 % for ω-3. The optimal ratio of ω-6: ω-3 fatty acids in the daily diet should be 5–10: 1. The physiological need for ω-6 and ω-3 fatty acids for children is: from 1 year to 14 years old 4–9 % and 0.8–1.0

% of the caloric content of the daily diet, from 15 to 17 years old 5–8 % and 1–2 %, respectively. Docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) are essential polyunsaturated fatty acids of the ω-3 family, found in the fats of cold-water fish, marine mollusks, diatoms and brown algae, etc.

An adequate intake level for children aged 6–24 months is 100 mg of DHA, for children aged 2–18 years and adults – 250 mg of DHA + EPA per day. During pregnancy and lactation, the need for DHA increases, determining the level of additional intake – 200 mg/day. Sufficient supply of DHA in pregnant and lactating women is associated with a reduced risk of miscarriage, improved visual functions in offspring.

It is recommended that EPA make up 1/3 of the daily intake of ω-3 PUFA, the rest is DHA.

Trans fatty acids (TFA) are unsaturated fatty acids with at least one double bond in the trans configuration.

Trans fatty acids are produced by bacteria in the stomach of ruminants as a result of biohydrogenation of polyunsaturated fatty acids of plants with the participation of hydrogen released by the rumen microbiocenosis, and are then absorbed in the intestine of the animal, included in the triacylglycerols of its cells. In products of animal origin (butter, meat and fat of cattle), the content of TFA is small (on average from 1 to 5 % of the total fatty acids). The main source of TFA in the human body are hydrogenated (hydrogenated) fats obtained during the industrial processing of liquid vegetable oils, during which they are formed as by-products of the partial hydrogenation reaction (addition of hydrogen at the site of double bonds) of unsaturated fatty acids. Hydrogenated fats can be included in margarines and spreads, frying fats, cocoa butter substitutes, confectionery fillings and other fatty products. High consumption of TFA is associated with an increased risk of complications and death due to coronary heart disease and other cardiovascular diseases. Consumption of trans fatty acids should not exceed 1 % of the daily caloric intake.

Sterols are a group of lipophilic steroids that are classified as unsaponifiable lipids due to their presence in natural objects together with lipid fractions. The main representative of sterols is cholesterol, which is found in food products of animal origin (exogenous cholesterol) and is synthesized by the human body (endogenous cholesterol). With normal metabolism, a balance of normal amounts of exogenous and endogenous cholesterol is maintained.

The main risk factors for the development of atherosclerosis of the vessels of the heart, brain and other organs are an increase in the level of total cholesterol and low-density lipoprotein cholesterol in the blood plasma, a decrease in the content of high-density lipoproteins and an increase in the concentration of triglycerides.

The amount of cholesterol from food in the daily diet of adults and children should not exceed 300 mg.

The analogue of cholesterol in food products of plant origin are phytosterols (plant sterols) and their saturated forms (phytostanols), which are minor biologically active substances of food.

Plant sterols are found in various types of plant foods and in seafood, and are an essential component of vegetable oils. They significantly reduce the level of free cholesterol in low-density lipoproteins and are capable of displacing cholesterol from membrane structures. Adequate consumption levels have been established for β-sitosterol, β-sitosterol-D-glycoside and stigmasterol and are 100 mg per day (for each).

Phospholipids are a diverse group of complex lipids, the structural component of which is phosphoric acid. Phospholipids are an essential component of plants and animals, where, along with proteins and other compounds, they participate in the construction of cell membranes and subcellular structures, perform various functions in biochemical processes occurring in a living organism, for example, they participate in the regulation of cholesterol metabolism and facilitate its elimination. Among natural phospholipids, the most common are phosphatidylcholines (lecithins), which include the vitamin-like substance choline. In the phospholipids of

oil seeds and animals, the content of lecithin reaches 30–50 %, the content of lecithin in the composition of phospholipids of egg yolk is 70 %. An adequate level of phospholipid consumption in the diet of an adult is 5–7 g/day.

Carbohydrates

Carbohydrates are polyatomic aldehyde and keto alcohols, which are divided into simple (mono- and disaccharides) and complex (oligo- and polysaccharides). Digestible carbohydrates (simple carbohydrates and starch) are the most important sources of energy.

The physiological need for digestible carbohydrates for an adult is 56–58 % of the daily energy requirement: from 301 to 551 g / day for men and from 238 to 435 g / day for women. The physiological need for carbohydrates – for children under 1 year old 13 g / kg of body weight per day, for children over 1 year old (with increasing age) – from 188 to 421 g/day.

Monosaccharides and disaccharides. Monosaccharides include glucose, fructose and galactose, and disaccharides include sucrose, lactose and maltose.

Sucrose (cane or beet sugar) is the most well-known and widely used carbohydrate in nutrition and the food industry, which is introduced (added) to food products during production, preparation and/or direct consumption (added sugars). Along with sucrose, other sugars (mono- and disaccharides) are added to food products, including those from honey, syrups, fruit and vegetable juices and their concentrates.

The consumption of added sugars for children and adults should not exceed 10 % of the daily caloric intake. For individuals with excess body weight (BMI 25–29) and obesity (BMI over 30), it is recommended to reduce the consumption of added sugars to 5 % of the daily caloric intake. These recommendations do not apply to the consumption of natural (own) sugars naturally found in unprocessed fruits, vegetables and milk.

Polysaccharides are complex carbohydrates, which are high-molecular compounds consisting of a large number of glucose monomers

and other monosaccharides, divided into starch (digestible) polysaccharides (starch and glycogen) and non-starch (indigestible) polysaccharides – dietary fiber (cellulose, hemicellulose, pectins and others).

Starch is the main polysaccharide that provides the body's physiological need for digestible carbohydrates.

Dietary fiber – edible parts of plants or similar carbohydrates that are resistant to digestion and adsorption in the human small intestine, completely or partially fermentable in the large intestine (polysaccharides, oligosaccharides, lignin and associated plant substances). Dietary fiber is a non-starch polysaccharide that is digested in the large intestine to a small extent, but has a significant effect on the processes of digestion, assimilation, microbiocenosis and evacuation of food residues. The effects of the physiological action of dietary fiber depend on their solubility in water. Soluble dietary fiber (pectin, alginates, polydextrose, etc.) can have an indirect effect on the metabolism of cholesterol and lipids (low-density lipoproteins and triglycerides), the glycemic load of food, glucose and insulin levels, exhibit a prebiotic effect, bind and remove heavy metals. Insoluble fibers (cellulose, hemicellulose, lignin) act as an enterosorbent and participate in the mechanism of preventing caries.

The physiological need for dietary fiber for an adult is 20–25 g/day or 10 g/1000 kcal, for children over 1 year old – 10–22 g/day.

Glycemic index of food products. In order to regulate the consumption of carbohydrates and, in particular, sugars, it is necessary to take into account the glycemic index – a relative indicator of the effect of carbohydrates contained in a food product on blood glucose levels. The glycemic index allows you to compare the glycemic effect of different food products containing an equal amount of carbohydrates and classify them depending on the severity of the postprandial glycemic effect.

The higher the glycemic index of a food product, the faster the glucose level in the blood rises. A product with a high glycemic index can cause a sharp increase in sugar levels, which is a health risk for people with diabetes. Products with a low glycemic index (less than 55) are di-

gested, absorbed and metabolized more slowly, which leads to a slower increase in blood glucose and insulin levels. Low glycemic index diets help control blood glucose levels and reduce the risk of developing type 2 diabetes and coronary heart disease.

Reference tables of glycemic indices of food products allow you to calculate the glycemic load, optimize your diet and avoid nutritional imbalances.

4.2.2. Micronutrients

Vitamins

Water-soluble vitamins

Vitamin C (forms and metabolites of ascorbic acid). Belongs to the group of non-enzymatic antioxidants, activates the biosynthesis of corticoid hormones responsible for the adaptive reactions of the body, causing an anti-stress effect, inhibits the processes of lipid peroxidation, which is associated with its membrane-stabilizing effect, has a capillary-strengthening effect, which is realized due to the fact that vitamin C significantly affects the formation of collagen fibers of blood vessels, skin, bone tissue and teeth, promotes the absorption of iron and normalizes hematopoiesis, participates in oxidation-reduction reactions, the functioning of the immune system.

Physiological requirement for adults is 100 mg/day.

Physiological requirement for children is from 30 to 90 mg/day.

Vitamin B1 (thiamine). Thiamine in the form of thiamine diphosphate formed from it is a part of the most important enzymes of carbohydrate and energy metabolism, providing the body with energy and plastic substances, as well as the metabolism of branched amino acids, plays a decisive role in the conversion of glucose into other sugars. Thiamine modulates the transmission of nerve impulses, regulates the transfer of sodium through the neuronal membrane, has an antioxidant effect.

With a deficiency of thiamine, carbohydrate metabolism is disrupted, which contributes to excessive accumulation of fat in the body, and also

leads to serious disorders of the nervous, digestive and cardiovascular systems.

The need for thiamine depends on the consumption of carbohydrates and energy, so the recommended intake of thiamine is related to energy intake. The physiological requirement for adults is 1.5 mg/day or 0.6 mg / 1000 kcal. The physiological requirement for children is from 0.3 to 1.5 mg/day.

Vitamin B2 (riboflavin). Riboflavin in the form of coenzymes participates in oxidation-reduction reactions, promotes increased color sensitivity by the visual analyzer and dark adaptation.

Insufficient intake of vitamin B2 is accompanied by a violation of the condition of the skin, mucous membranes, and impaired light and twilight vision.

Physical activity affects riboflavin status, so the need for this vitamin can be expressed per unit of energy value of the diet. The physiological need for adults is 1.8 mg/day or 0.75 mg / 1000 kcal. The physiological need for children is from 0.4 to 1.8 mg/day.

Vitamin B6 (pyridoxine). Pyridoxine in the form of its coenzymes is involved in the conversion of amino acids, the metabolism of tryptophan, lipids and nucleic acids, is involved in maintaining the immune response, the processes of inhibition and excitation in the central nervous system, promotes the normal formation of red blood cells, maintaining normal levels of homocysteine in the blood.

Insufficient intake of vitamin B6 is accompanied by a decrease in appetite, disruption of the condition of the skin, the development of homocysteine and anemia.

Physiological need for adults is 2.0 mg/day. Physiological need for children is from 0.4 to 2.0 mg/day.

Niacin. As a coenzyme, it is involved in oxidation-reduction reactions of energy metabolism, promotes the absorption of vegetable protein.

Insufficient niacin intake is accompanied by disruption of the normal condition of the skin, gastrointestinal tract and nervous system.

The need for niacin depends on energy intake. The physiological requirement for adults is 20 mg niacin equiv./day or 8 mg niacin equiv./1000 kcal. The physiological requirement for children is from 5 to 20 mg niacin equiv./day.

Vitamin B12. Plays an important role in the metabolism and transformation of amino acids. Folate and vitamin B12 are interrelated vitamins, involved in hematopoiesis.

Vitamin B12 deficiency leads to the development of partial or secondary folate deficiency, as well as anemia, leukopenia, thrombocytopenia. The physiological requirement for adults is 3.0 mcg/day. The physiological requirement for children is from 0.3 to 3.0 mcg/day.

Folates. As a coenzyme, they participate in the metabolism of nucleic and amino acids. Folate deficiency leads to disruption of the synthesis of nucleic acids and protein, which results in inhibition of cell growth and division, especially in rapidly proliferating tissues (cells): bone marrow, intestinal epithelium, etc.

Insufficient folate intake during pregnancy is one of the causes of prematurity, hypotrophy, congenital malformations and developmental disorders in children. A strong relationship has been shown between the level of folate, homocysteine and the risk of cardiovascular diseases. 1 mcg folate equivalent of food = 1 mcg of folates in food = 0.6 mcg of folic acid from fortified foods and dietary supplements. The physiological requirement for adults is 400 mcg/day.

The physiological requirement for children is from 50 to 400 mcg/day.

Pantothenic acid. Participates in protein, fat, carbohydrate and cholesterol metabolism, synthesis of a number of hormones, hemoglobin, promotes absorption of amino acids and sugars in the intestine, supports the function of the adrenal cortex.

A deficiency of pantothenic acid can lead to damage to the skin and mucous membranes. The physiological requirement for adults is 5 mg/day. The physiological requirement for children is from 1.0 to 5.0 mg/day.

Biotin. Participates in the synthesis of fats, glycogen, and amino acid metabolism.

Insufficient consumption of this vitamin can lead to disruption of the normal condition of the skin.

The physiological requirement for adults is 50 mcg/day. The physiological requirement for children is from 10 to 50 mcg/day.

Fat-soluble vitamins

Vitamin A. Plays an important role in the processes of growth and reproduction, differentiation of epithelial and bone tissue, maintenance of immunity and vision.

Vitamin A deficiency leads to impaired dark adaptation ("night blindness" or hemeralopia), keratinization of the skin, and reduces resistance to infections.

The physiological requirement for men is 900 mcg ret. equiv./day, for women 800 mcg ret. equiv./day. The physiological requirement for children is from 400 to 1000 mcg ret. equiv./day.

Beta-carotene. Is a provitamin A and has antioxidant properties; 6 mcg of beta-carotene or 12 mcg of beta-carotene from food are equivalent to 1 mcg of vitamin A (ret. equiv.). The physiological requirement for adults is 5 mg/day.

Vitamin E (α-tocopherol, as well as β-, γ-, δ-tocopherols). It is an antioxidant, a universal stabilizer of cell membranes, necessary for the functioning of the sex glands and the heart muscle.

With a deficiency of α-tocopherol, hemolysis of erythrocytes and neurological disorders are observed. The need for vitamin E increases with an increase in the consumption of PUFAs and the degree of their unsaturation, amounting to 0.4–0.6 mg current. equiv. α-tocopherol for every 1 g of PUFAs.

Physiological need for adults is 15 mg current. equiv./day. Physiological need for children is from 3 to 15 mg current. equiv./day.

Vitamin D. The main functions of vitamin D (ergocalciferol, cholecalciferol, 25-hydroxyvitamin D3, etc.) are associated with maintaining calcium and phosphorus homeostasis and bone mineralization processes.

Vitamin D deficiency leads to impaired calcium and phosphorus metabolism in bones, increased demineralization of bone tissue, which leads to an increased risk of osteoporosis. Reduced serum concentrations of 25(OH)D are associated with a number of extraskeletal diseases (some types of cancer, arterial hypertension, age-related decline in cognitive ability, impaired immune and reproductive systems, etc.).

The physiological requirement for adults is 15 mcg/day (600 IU), for people over 65 years of age – 20 mcg/day (800 IU). The physiological requirement for children is from 10 to 15 mcg/day.

Vitamin K (phylloquinone and menaquinones). The metabolic role of vitamin K is due to its participation in the modification of a number of proteins of the blood coagulation system and bone tissue.

Vitamin K deficiency leads to an increase in blood clotting time, a reduced content of prothrombin in the blood. Adequate intake of vitamin K2 (menaquinones) is associated with a reduced risk of cardiovascular diseases.

Physiological requirement for adults is 120 mcg/day. Physiological requirement for children is from 30 to 120 mcg/day.

4.2.3. Minerals

Macroelements

Calcium. An essential element of the bone mineral matrix, plays a leading role in nerve conduction and blood clotting, and is involved in muscle contraction.

Calcium deficiency leads to demineralization of the spine, pelvic bones, and lower extremities, and increases the risk of osteoporosis.

The physiological requirement for adults is 1000 mg/day, for people over 65 years old – 1200 mg/day. The physiological requirement for children is from 400 to 1200 mg/day.

Phosphorus. In the form of phosphates, it participates in many physiological processes, including energy metabolism (in the form of high-energy ATP), regulation of acid-base balance, is part of phospholipids, nucleotides, and nucleic acids, participates in cellular regulation by phosphorylation of enzymes, and is necessary for the mineralization of bones and teeth.

Deficiency leads to anorexia, anemia, and rickets. The optimal ratio of calcium to phosphorus in the diet for calcium absorption and assimilation is 1:1.

The physiological requirement for adults is 700 mg/day. The specified physiological requirement for children is from 300 to 900 mg/day.

Magnesium. It is a cofactor of many enzymes of carbohydrate-phosphorus and energy metabolism, participates in the synthesis of proteins, nucleic acids, has a stabilizing effect on membranes, is necessary for maintaining the homeostasis of calcium, potassium and sodium.

Magnesium deficiency leads to hypomagnesemia, an increased risk of hypertension and heart disease.

The specified physiological requirement for adults is 420 mg/day. The physiological requirement for children is from 55 to 400 mg/day.

Potassium. It is the main intracellular electrolyte, playing an important role in maintaining membrane potential, participates in the regulation of water, acid and electrolyte balance, participates in the processes of conducting nerve impulses, and blood pressure regulation. Food rich in potassium causes increased excretion of sodium from the body and, conversely, increased sodium intake leads to loss of potassium by the body.

Potassium intake of 3500 mg (90 mmol) per day has a beneficial effect on blood pressure in adults. Potassium intake of less than 3500 mg (90 mmol) per day is associated with an increased risk of stroke and other cardiovascular diseases.

The specified physiological requirement for adults is 3500 mg/day. The physiological requirement for children is from 1000 to 3200 mg/day.

Sodium. It is the main extracellular electrolyte that is involved in providing the necessary blood buffering, regulating blood pressure, water metabolism, swelling of tissue colloids and water retention in the body, activating digestive enzymes, transporting blood glucose, generating and transmitting electrical nerve signals, and muscle contraction.

The physiological requirement for adults is 1300 mg/day. The physiological requirement for children is from 200 to 1300 mg/day.

High sodium intake is associated with the risk of developing arterial hypertension. With a deficiency of potassium, magnesium and calcium, excess sodium aggravates the negative impact on the body, since these four mineral elements perform an important interaction in the control of cardiac output and vascular resistance.

The amount of sodium coming from food in the daily diet of adults and children should not exceed 2 g per day.

Chlorides. Chlorine is necessary for the formation and secretion of hydrochloric acid. The physiological requirement for adults is 2300 mg/day.

The physiological requirement for children is from 300 to 2300 mg/day.

Microelements

Iron. It is an essential part of hemoglobin and myoglobin, is part of cytochromes, catalase and peroxidase. Participates in the transport of electrons, oxygen, ensures the occurrence of oxidation-reduction reactions and the activation of peroxidation. Iron, depending on the valence, has both an antioxidant and a prooxidant effect.

Insufficient consumption leads to hypochromic anemia, myoglobin deficiency atony of skeletal muscles, increased fatigue, cardiomyopathy, atrophic gastritis.

Physiological requirement for adults is 10 mg/day (for men) and 18 mg/day (for women). Physiological requirement for children (depending on the child's gender) is from 4 to 18 mg/day.

Zinc. It plays an important role in metabolic processes, is a part of many enzymes, participates in the processes of synthesis and breakdown of carbohydrates, proteins, fats, nucleic acids and in the regulation of gene expression, affects the activity of hormones and vitamins.

Insufficient consumption leads to anemia, secondary immunodeficiency, liver cirrhosis, sexual dysfunction, and fetal malformations. The ability of high doses of zinc to disrupt the absorption of copper and thereby contribute to the development of anemia has been revealed.

Physiological requirement for adults is 12 mg/day. Physiological requirement for children is from 3 to 12 mg/day.

Iodine. Participates in the functioning of the thyroid gland, ensuring the formation of hormones (thyroxine and triiodothyronine), which are necessary for the growth and differentiation of cells of all tissues of the human body, mitochondrial respiration, regulation of transmembrane transport of sodium and hormones.

Insufficient intake leads to endemic goiter with hypothyroidism and slow metabolism, arterial hypotension, growth retardation and mental retardation in children.

Physiological requirement for adults is 150 mcg/day. Physiological requirement for children is 70 to 150 mcg/day.

Copper. It is a part of enzymes with oxidation-reduction activity and involved in iron metabolism, stimulates the absorption of proteins and carbohydrates. It is involved in the processes of providing human tissues with oxygen. It is an indirect antioxidant.

Clinical manifestations of insufficient intake are manifested in the disruption of the formation of the cardiovascular system and skeleton, the development of connective tissue dysplasia.

Physiological requirement for adults is 1.0 mg/day. Physiological requirement for children is 0.5 to 1.0 mg/day.

Manganese. Participates in the formation of bone and connective tissue, is part of enzymes involved in the metabolism of amino acids, carbo-

hydrates, catecholamines, necessary for the synthesis of cholesterol and nucleotides. Is an indirect antioxidant.

Insufficient consumption is accompanied by slower growth, reproductive system disorders, increased fragility of bone tissue, carbohydrate and lipid metabolism disorders.

The physiological requirement for adults is 2 mg/day. The physiological requirement for children aged 7 to 11 months is 0.02–0.5 mg/day, 1–2 years – 0.5 mg/day, 3–6 years – 1.0 mg/day, 7–10 years – 1.5 mg/day, 11–14 years – 2.0 mg/day, 15–17 years – 3.0 mg/day (introduced for the first time).

Molybdenum. It is a cofactor of many enzymes that ensure the metabolism of sulfur-containing amino acids, purines and pyrimidines.

Physiological requirement for adults is 70 mcg/day. Physiological requirement for children aged 7–11 months is 10 mcg/day, 1–2 years – 15 mcg/day, 3–6 years – 20.0 mcg/day, 7–10 years – 30 mcg/day, 11–14 years – 45 mcg/day, 15–17 years – 65 mcg/day (introduced for the first time).

Selenium. Performs catalytic, structural and regulatory functions, interacts with vitamins, enzymes and biological membranes, participates in oxidation-reduction processes, metabolism of proteins, fats and carbohydrates. An essential element of the antioxidant defense system of the human body, has an immunomodulatory effect, etc. A correlation has been found between the dietary need for selenium and vitamin E, and with insufficient intake of tocopherol in the body, selenium can prevent the development of vitamin E deficiency symptoms. Deficiency leads to Kashin-Beck disease (osteoarthritis with multiple deformation of the joints, spine and limbs), Keshan disease (endemic cardiopathy), hereditary thrombasthenia.

Physiological need for adults is 55 mcg/day for women, 70 mcg/day for men. Physiological need for children is from 10 to 50 mcg/day.

Chromium. Normalizes the permeability of cell membranes for glucose, the processes of its use by cells and deposition, increases the sensitivity of tissue receptors to insulin, reducing the body's need for insulin. Deficiency leads to decreased glucose tolerance, as well as increased tri-

glycerides and cholesterol. The effect of chromium on lipid metabolism is mediated by its regulatory effect on insulin functioning.

The specified physiological requirement for adults is 40 mcg/day. The physiological requirement for children is from 11 to 35 mcg/day.

Cobalt. Part of vitamin B12. Activates enzymes of fatty acid metabolism and folic acid metabolism. Adequate intake for adults is 10 mcg/day.

Fluorine. Initiates bone mineralization. Insufficient intake leads to caries, premature abrasion of tooth enamel.

Adequate intake for adults is 4 mg/day. Adequate intake for children over 7 months is from 0.4 to 3.2 mg/day.

Silicon. It is a structural component of glucosaminoglycans and stimulates collagen synthesis. Adequate intake level for adults is 30 mg/day.

Vanadium. One of the supposed functions of vanadium is to activate the activity of phagocytes. Vanadium prevents the accumulation of cholesterol, the development of atherosclerosis, and is involved in the regulation of blood sugar levels and calcium metabolism. Adequate intake level for adults is 15 mcg/day.

4.2.4. Minor biologically active substances of food

Myoinositol (inositol). Participates in the metabolism of carbohydrates and purines, the synthesis of phospholipids. Adequate intake for adults is 500 mg/day; for children 0–12 months – 30–40 mg/day; 1–3 years – 50–60 mg/day; 4–6 years – 80–100 mg/day; 7–18 years – 200–500 mg/day.

L-Carnitine. Plays an important role in energy and lipid metabolism, carrying out the transfer of long-chain fatty acids through the inner membrane of mitochondria for their subsequent oxidation.

Adequate intake for adults is 300 mg/day; for children 0–12 months – 10–15 mg/day; 1–3 years – 30–50 mg/day; 4–6 years – 60–90 mg/day; 7–18 years – 100–300 mg/day.

Coenzyme Q10 (ubiquinone). Participates in energy metabolism, promoting the synthesis of ATP. Has antioxidant activity.

Adequate intake level for adults is 30 mg/day.

Lipoic acid. Is part of mitochondrial multienzyme complexes, participates in glucose metabolism and modulates the activity of signaling molecules. Adequate intake level for adults is 30 mg/day.

Methylmethionine sulfonium. Participates in metabolism as a donor of methyl groups in biological methylation reactions. Adequate intake level for adults is 200 mg/day.

Orotic acid. Provides synthesis of nucleotides and nucleic acids. The adequate intake level for adults is 300 mg/day.

Para-aminobenzoic acid. Participates in protein metabolism and hematopoiesis. The adequate intake level for adults is 100 mg/day.

Choline. Is part of lecithin, plays a role in phospholipid metabolism in the liver, is a source of free methyl groups, and acts as a lipotropic factor.

The adequate intake level for adults is 500 mg/day; for children 0–12 months – 50–70 mg/day; 1–3 years – 70–90 mg/day; 4–6 years – 100–200 mg/day; 7–18 years – 200–500 mg/day.

Indole-3-carbinol. Induces the activity of xenobiotic metabolism enzymes (monooxygenase system). The adequate level of indole-3-carbinol consumption for adults is 50 mg/day.

Glucosamine sulfate. It is part of polysaccharides, which are structural elements of organs and tissues (nails, ligaments, skin, bones, tendons, articular surfaces, heart valves, etc.).

The adequate level of consumption for adults is 700 mg/day.

Carnosine. It is part of meat and fish, has antioxidant activity. The adequate level of carnosine consumption for adults is 200 mg/day (introduced for the first time).

Phenolic compounds. They are widely represented in food products of plant origin. They have an antioxidant effect, participate in the regulation of the protective and adaptive potential of the body.

The main phenolic compounds include representatives of phenolic (hydroxybenzoic and hydroxycinnamic) acids, flavonoids (flavonols, flavanones, flavan-3-ols, flavones, anthocyanins, isoflavonoids), polymeric phenolic compounds (condensed and hydrolyzable tannins) and stilbenes. For adults, adequate intake levels of phenolic compounds are: for hydroxybenzoic acids - 50 mg/day, hydroxycinnamic acids – 200 mg/day, flavonols – 30 mg/day, flavanones – 30 mg/day, flavan-3-ols – 200 mg/day, flavones – 10 mg/day, anthocyanins – 50 mg/day, isoflavonoids – 2 mg/day, condensed tannins – 200 mg/day, hydrolyzable tannins – 200 mg/day, stilbenes – 2 mg/day (introduced for the first time). For children aged 7–18 years, adequate intake levels of flavonoids are from 150 to 250 mg/day, including flavan-3-ols (catechins) – from 50 to 100 mg/day.

5. Determination of the body's energy requirements and justification of the energy value and nutrient composition of diets

Energy requirement is the amount of energy required to maintain health, growth and an appropriate level of physical activity.

Energy requirement is determined by the level of energy expenditure.

Energy expenditure can be determined by direct, indirect (respiratory) and alimentary energy measurement methods, as well as the chronometric-tabular method.

The direct energy measurement method determines the body's energy expenditure by accurately recording the heat released by the body under various living conditions.

The indirect (respiratory) energy measurement method is based on determining the chemical composition of the air inhaled and exhaled by a person, followed by establishing the respiratory quotient.

The alimentary energy measurement method is based on accurately recording the energy value of food and monitoring body weight over time.

The simplest and fastest method for approximately determining a person's energy expenditure is the chronometric-tabular method.

Daily energy expenditure of the body consists of the energy of the basal metabolism, the energy of the specific dynamic action of food, the energy caused by the neuromuscular activity of a person and the amount of unaccounted energy expenditure.

Since the value of the basal metabolism (BMR) depends on age and body weight, three age ranges are distinguished for adults of both sexes: 18–30, 30–60, 60 years and older (Appendix №. 1). BMR for each age range is determined by an equation taking into account the ideal body weight (average weight corresponding to age, sex, height) (Appendix №. 2).

The main decisive factor on which the value of daily energy expenditure depends is physical work, active recreation, physical education and mental activity. The norms of physiological needs for energy and nutrients of the working-age population are differentiated depending on the nature of labor activity into 5 groups for men and 4 groups for women.

To determine energy expenditure, first the daily time budget is measured and a chronogram of the day is compiled. Then, using special tables (Appendix No. 3), energy expenditure is calculated for individual types of activity and for the day as a whole.

In the tables, energy expenditure is given in kcal per 1 kg of body weight per minute, including expenditures associated with the basal metabolism.

After calculating the total energy expenditure for various types of activity during the day, it is necessary to determine the amount of unaccounted energy expenditure. It is 5 % of the total energy expenditure for various types of activity.

The value of the basal metabolism is used to determine the specific dynamic effect of food, i.e. the increase in metabolism after eating.

When consuming predominantly carbohydrate foods, the energy of the specific dynamic action is 4–7 % of the basal metabolism, and 4–17 % for a fat diet. Protein foods increase the basal metabolism by 30–40 %. On average, with normal diets, this increase is 10 %.

We find the required amounts of proteins, fats, carbohydrates. Knowing that proteins should make up 13 %, fats – 33 %, carbohydrates – 54 % of the daily caloric content. For example, it is necessary to determine the needs for proteins, fats, carbohydrates for a 25-year-old man, whose energy expenditure is 2800 kcal.

2800 kcal – 100 %

X – 13 % **proteins** $X = \frac{2800 \times 13}{100} = 364\ kcal$

2800 – 100 %

X – 33 % **fats** $X = \frac{2800 \times 33}{100} = 924\ kcal$

$2800 - (364 + 924) = 1512\ kcal$ **carbohydrates**

Thus, proteins should provide 364 kcal, fats – 924 kcal, carbohydrates – 1512 kcal. Dividing by the corresponding caloric coefficients (energy value during oxidation in the body) we find the number of grams of proteins, fats, carbohydrates, to which this caloric value corresponds.

364 kcal : 4 kcal / g = 91 g **proteins (P)**

924 kcal : 9 kcal / g = 103 g **fats (F)**

1512 kcal: 4 kcal / g = 378 g **carbohydrates (C)**

The balance of nutrients in its simplest form can be represented as the ratio of proteins, fats and carbohydrates, like

P : F : C = 1 : 1,2 : 4,6,

where the mass of protein is taken as unity.

The need for vitamins is calculated per megacalorie, i.e. per 1000 kcal

B1 per 1000 kcal requires 0.6 mg

2800 kcal requires X mg

$$X = \frac{2800 \times 0{,}6}{1000} = 1{,}68\ mg$$

Vit C per 1000 kcal requires 25 mg of Vit C

for 2800 kcal – X mg

$$X = \frac{2800 \times 25}{1000} = 70\ mg$$

Topic 2. Methods for assessing the adequacy of diet to physiological needs

1. Relevance of the topic, purpose, content of the lesson

Nutrition is a means of maintaining life, growth and development, health and high performance of a person. All vital functions of the body are associated with nutrition. Nutrition ensures the development and continuous renewal of cells and tissues, the supply of energy necessary to replenish the body's energy expenditure at rest and during physical exertion, and is a source of substances from which enzymes, hormones and other regulatory substances are formed in the body.

Objective of the lesson:

To assess the adequacy of nutrition to the body's needs for nutrients and energy based on the study of an individual diet.

The student must:

- to know:

Biological action of essential nutrients

- to be able to:

1. Make a menu for the day
2. Calculate the daily diet for nutrients.
3. Assess the adequacy of the diet to physiological needs.
4. Give recommendations for adjusting the daily diet

Questions for self-control.

1. Concept of the menu.
2. Ratio of proteins, fats and carbohydrates in the daily diet.
3. Biological significance of the main nutrients.
4. Basic requirements for food.
5. Diet, its significance.
6. Biological value of proteins, fats, carbohydrates.
7. Diseases associated with insufficient or excessive nutrition
8. Population groups depending on the nature of work.
9. Concept of rational nutrition.

10. Basic principles of balanced nutrition

Contents of the lesson

1. Make a menu of products for meals and for the whole day.
2. Calculate the chemical composition of the diet for the day.
3. Assess the diet based on the calculations obtained.
4. Give recommendations on the adequacy of the diet.

2. Rational nutrition. Requirements for diet

Rational nutrition is a properly organized and timely supply of the body with nutritious and tasty food containing the optimal amount of various nutrients necessary for its development and functioning. The main elements of rational nutrition are balance and proper diet.

Balanced nutrition is nutrition that provides optimal ratios of food and biologically active substances.

A product is a natural object used for cooking, it is a complex mixture of food substances (nutrients).

A diet is the composition and amount of food products used during the day.

Food is a complex mixture of food products subjected to culinary processing and taken in certain quantities.

Basic hygiene requirements for food

1. food should have sufficient caloric content to compensate for the body's energy expenditure

2. contain all the necessary nutrients for building tissues and organs, and normal physiological processes

3. have a small volume and a certain temperature

4. be easily and well digestible

5. cause appetite and a feeling of satiety

6. have a pleasant smell, taste and appearance

7. contain a sufficient amount of fiber

8. be of good quality, i.e. harmless

The menu is the amount of food products that is needed to prepare a particular dish. There is no such product that would satisfy human needs. In order for nutrition to be adequate to the physiological needs of the body, it is necessary to leave such diets where the composition and quantity of food products are regulated in accordance with the requirements of rational nutrition.

Requirements for rational nutrition consist of requirements for the diet, diet, conditions of food intake.

Dietary requirements

1. The daily diet should correspond in energy value to the body's energy expenditure. Energy requirements depend on age and the associated basal metabolic rate (BMR), gender, constitution, professional activity, quality of life and living conditions, and climate.

2. The diet should be adequate to physiological needs:

a) The amount of food elements should be sufficient to cover energy expenditure and all metabolic processes in the body. For this, the proportion of proteins in the diet should be 11–13 %, the proportion of fats – 30 %, the proportion of carbohydrates – 56–58 % of the daily caloric value;

b) The quality of food is determined by the balance (favorable ratio) of food elements. Balance ensures their high digestibility in the body.

The balance of food elements can be represented for proteins, fats, carbohydrates as 1:1.2:4.6 (where the mass of protein should be taken as a unit).

For mineral elements, the following ratios must be taken into account: Ca: P: Mq in the form of 1: 1.5: 0.5.

Animal proteins must be present in the diet within 55 to 60 % of the total amount of protein.

Vegetable fats should make up 20–25 % of the total amount of fat in the diet. The balance of vitamins is calculated based on the calculation in mg for every 1000 kcal of the energy value of the diet: C – 25 mg, B1 – 0.7 mg, B2 – 0.8 mg, B6 – 1 mg, PP – 6 mg, folate – 0.1 mg, A – 0.5 IU, E – 8 mg.

3. The chemical structure of food should correspond as much as possible to the enzymatic digestive systems of the body. Any violation of the correspondence of the chemical structure of food to the enzymatic composition leads to metabolic disorders and diseases.

4. The diet should be properly distributed throughout the day. The diet includes hours, the number of meals during the day, intervals between meals, and uniform distribution of the daily caloric intake among meals. For an adult, 3–4 meals a day with a 4–5 hour interval are recommended. Uniform distribution of the daily energy value of the diet among meals: with three meals a day – breakfast 30 %, lunch 45 %, dinner 25 %; with four meals a day – breakfast 25 %, second breakfast 15 %, lunch 35 %, afternoon snack 15 %, dinner 25 %.

5. Rational nutrition must be impeccable in sanitary and epidemiological terms. Products must not pose a health hazard due to the presence of physical, chemical or biological contaminants or spoilage processes due to improper storage and sale.

The conditions of food intake are important, namely the appropriate environment, table setting, service, the absence of factors that distract from food. All this contributes to a good appetite, better absorption and digestion of food.

Proteins play a great role in ensuring the vital activity of the body. They are the main component of all organs and tissues, all vital processes, metabolism, contractility, irritability, growth, reproduction, thinking are associated with proteins. Proteins of the body, enzymes, hormones, antibodies are constantly synthesized from food proteins. Proteins are involved in the transport of oxygen, lipids, carbohydrates, vitamins, hormones by the blood. Protein is an essential component of food.

The criterion for the biological value of a protein is the amino acid composition, the ratio of essential replaceable amino acids.

Fats are essential components of food. They participate in the construction of cell membranes, perform energy, protective, hormonal func-

tions, PUFAs are vitamins and vitamin solvents. The biological value of fats is determined by the ratio of PUFAs, monounsaturated and saturated.

Carbohydrates are the main component of the human diet. They perform a plastic, energy function. Dietary fiber (polysaccharides) plays a major role in nutrition. They affect the intensity of absorption and metabolism of essential nutrients, promote the movement of food, remove harmful substances from the body, and reduce cholesterol levels.

Dietary fiber is found in cereals, fruits, vegetables, nuts. It should be at least 25 grams in the daily diet.

Vitamins come with food and are considered essential nutritional factors. They act as catalysts for metabolic processes. Minerals ensure the maintenance of homeostasis, participate in ensuring life activity, their deficiency leads to specific disorders and diseases.

Practical part of the lesson

1. Assess the characteristics of actual nutrition using the recording method based on the analysis of food diaries that students keep for one week (7 days), recording the time, quantity and what was eaten (Appendices 5, 6).

2. Then process the obtained data using the diet analysis program «My Healthy Diet» (https://health-diet.ru). The choice of this program was due to several reasons: information content; non-invasiveness; cost-effectiveness and availability (the program is available on the website and as a mobile application with synchronization on various devices); simplicity and convenience in everyday use; a large database of products and dishes, including SPPS; use of competent sources of the chemical composition of products included in the program database; taking into account individual characteristics (gender, body weight, age, level of physical activity, body type) when calculating individual needs for macro- and micronutrients; the possibility of use in a one-time examination of a large number of people.

3. Conduct an analysis of the results in accordance with MR 2.3.1.0253-21 «Norms of physiological needs for energy and nutrients for various groups of the population of the Russian Federation», taking into account the group of physical activity and labor intensity. Next, the average values of the indicators for the week are calculated, which are entered into the final protocol.

4. Conduct an analysis of students' diets in terms of the sufficiency of daily nutrient intake. For this, the following gradation of the level of insufficiency of daily nutrient intake is used:

- high level of insufficiency – less than 50 % of the norm;
- average level of insufficiency – 50–75 %;
- low level of insufficiency – 75–90 %;
- normal – 90–110 %;
- above normal – more than 110 %.

5. Assess the compliance of the diet with the recommended standards.

6. Provide recommendations for dietary correction.

7. Issue a conclusion on the work performed in comparison with the nutritional standards (Appendix 4).

Test control questions:

1. **What is meant by a diet?** (select several correct answers)
   1) Correspondence of energy expenditure to the energy value of the diet
   2) Intervals between meals
   3) Frequency of meals
   4) Optimal ratio between food and biologically active substances
   5) Quantitative distribution of food among individual meals

2. **Give a definition of the concept of "Adequate nutrition"?**
   1) Nutrition that provides all the physiological needs of the body.
   2) Nutrition that completely restores the body's energy expenditure and ensures the intake of a sufficient amount of nutrients.
   3) Nutrition that completely restores the body's energy expenditure and ensures the intake of nutrients in sufficient quantities and their optimal ratio.

3. **What indicators are used to determine the quantitative adequacy of nutrition to the needs of the body?** (select several correct answers)
   1) Energy expenditure
   2) Energy value of the diet
   3) Content of animal proteins
   4) Ratio between proteins, fats and carbohydrates
   5) Content of macronutrients

4. **What kind of nutrition is called rational?**
   1) Satisfying the energy and plastic needs of the body.
   2) In which optimal ratios of food and biologically active substances are provided.
   3) Satisfying the energy, plastic and other needs of the body, ensuring the necessary level of metabolism.

4) In which the ratio of proteins, fats, carbohydrates is 1:1.2:4.7.
5) In which vegetable proteins make up at least 30 % of the total amount.

5. What kind of nutrition is called balanced?

1) Satisfying the body's energy and plastic needs.
2) In which optimal ratios of food and biologically active substances are provided.
3) Satisfying the body's energy, plastic and other needs, providing the necessary level of metabolism.
4) In which the ratio of proteins, fats, carbohydrates is 1:1.2:4.7.
5) In which vegetable proteins make up at least 30 % of the total amount.

6. The value of the basal metabolism is influenced by (select several correct answers):

1) The state of the central nervous system
2) The intensity of the endocrine system function
3) The volume and nature of muscle activity
4) The sex and age of a person
5) The nature of mental work

7. Regulated energy expenditure is:

1) Energy expenditure during labor activity
2) Energy expenditure on the basal metabolism
3) Energy expenditure on the specific dynamic action of food
4) Energy expenditure during sleep
5) Energy expenditure during sports

8. What is the formula for calculating the Quetelet index?

1) Weight (kg) / height (cm2) - 100.

2) Weight (kg) / length (m2).
3) Ideal body weight +100.

9. What does the biological value of proteins depend on?

1) On the content of essential polyunsaturated fatty acids
2) On the ratio of proteins, fats and carbohydrates
3) On the content of essential amino acids
4) On the distribution of food into separate meals
5) On the functional state of the gastrointestinal tract

10. What does the biological value of fats depend on?

1) On the ratio of proteins, fats and carbohydrates
2) On the content of essential amino acids
3) On the functional state of the gastrointestinal tract
4) On the content of polyunsaturated fatty acids
5) On the ratio of saturated and unsaturated fatty acids

11. Polyunsaturated fatty acids include (select several correct answers):

1) Glutamic
2) Arachidonic
3) Oleic
4) Linolenic
5) Capric

12. Which of the listed vitamins are water-soluble? (select several correct answers)

1) B1 (thiamine)
2) A (retinol)
3) C (ascorbic acid)
4) D (calciferols)
5) PP (niacin).

13. The value of the basal metabolic rate is affected by (select several correct answers):

1) The state of the central nervous system
2) The intensity of the endocrine system
3) The volume and nature of muscle activity
4) The person's gender and age
5) The nature of mental work

14. What disease develops with a lack of thiamine in the body?

1) Endemic goiter
2) Scurvy
3) Alimentary polyneuritis
4) Hemeralopia
5) Pellagra

15. Which food set includes products that are the main sources of iron?

1) Pork and beef liver, egg yolk, buckwheat, millet.
2) Rye and wholemeal bread, pork liver, vegetables and fruits.
3) Milk, dairy products.

16. Which food set includes products that are the main sources of carotene?

1) Rye bread, oatmeal, carrots, tomatoes.
2) Carrots, apricots, tomatoes, red peppers, sea buckthorn.
3) Dairy products: milk, cream, sour cream, butter.

17. Which food set includes products that are richest in vitamin C? (indicate one answer)

1) All vegetables and fruits of red-orange color.

2) Rose hips, black currants, bell peppers, sea buckthorn.
3) Rose hips, black currants, apples, citrus fruits.

18. Which food set includes products that are the main sources of vitamins B?

1) Cereals (buckwheat, millet, oatmeal), wholemeal and rye bread.
2) Sea fish, fish products
3) Dairy products.
4) Vegetables and fruits

19. Which food products are the main source of calcium?

1) Milk, dairy products.
2) Vegetables and fruits.
3) Rye bread, cereals (oatmeal, wheat, buckwheat).

20. Which of the listed minerals are microelements? (select several correct answers)

1) Iodine
2) Potassium
3) Calcium
4) Copper
5) Sulfur

21. Meat products can be considered as sources of minerals: (select several correct answers)

1) Calcium
2) Potassium
3) Iron
4) Phosphorus
5) Magnesium

22. Insufficient amounts of dietary fiber in the diet are associated with… (select several correct answers)

1) Atherosclerosis
2) Hemeralopia
3) Kwashiorkor
4) Colon cancer
5) Obesity

23. What changes in the body does a long-term negative energy balance lead to? (select several correct answers)

1) Atherosclerosis
2) Alimentary dystrophy
3) Calorie-protein deficiency
4) Obesity
5) Hypertension

24. What changes in the body does a long-term positive energy balance lead to?

1) Atherosclerosis
2) Alimentary dystrophy
3) Caloric-protein deficiency
4) Obesity
5) Hypertension

Correct answers to test questions on the topic

1	2	3	4	5	6	7	8	9	10	11	12
2, 3, 5	3	1, 2	3	2	1, 2, 4	1, 5	1	3	4	2, 4	1, 3, 5

13	14	15	16	17	18	19	20	21	22	23	24
3	5	1	2	1	1	1	1, 4	3, 4. 5	1, 4, 5	2, 3	4

References

1. Королев А. А. Гигиена питания: Руководство для врачей / А. А. Королев. – М.: ГЭОТАР-Медиа, 2016. – 624 с. – ISBN 978-5-9704-3706-3. – Текст: электронный // ЭБС «Консультант студента»: [сайт]. – URL: https://www.studentlibrary.ru/book/ISBN9785970437063.html (дата обращения: 03.04.2025). – Режим доступа: по подписке.

2. МР 2.3.1.0253-21 «Нормы физиологических потребностей в энергии и пищевых веществах для различных групп населения Российской Федерации» / М., 2021. – 72 с.

3. Кича Д. И. Общая гигиена. Руководство к лабораторным занятиям: учебное пособие / Кича Д. И. , Дрожжина Н. А. , Фомина А. В. – М.: ГЭОТАР-Медиа, 2015. – 288 с. – ISBN 978-5-9704-3430-7. - Текст: электронный // ЭБС «Консультант студента»: [сайт]. - URL: https://www.studentlibrary.ru/book/ISBN9785970434307.html (дата обращения: 03.04.2025). – Режим доступа: по подписке.

4. Бражников А. Ю. Общая эпидемиология с основами доказательной медицины. Руководство к практическим занятиям: учебное пособие / Под ред. В. И. Покровского. – 2-е изд., испр. и доп. – М.: ГЭОТАР-Медиа, 2012. – 496 с. – ISBN 978-5-9704-1778-2. – Текст: электронный // ЭБС «Консультант студента»: [сайт]. – URL: https://www.studentlibrary.ru/book/ISBN9785970417782.html (дата обращения: 01.02.2025). – Режим доступа: по подписке.

5. Плетенёва, Т. В. Токсикологическая химия / Плетенева Т. В. , Сыроешкин А. В. , Максимова Т. В.; Под ред. Т. В. Плетенёвой. – М.: ГЭОТАР-Медиа, 2013. – 512 с. – ISBN 978-5-9704-2635-7. – Текст: электронный // ЭБС «Консультант студента»: [сайт]. – URL: https://www.studentlibrary.ru/book/ISBN9785970426357.html (дата обращения: 03.04.2025). – Режим доступа: по подписке.

6. ВОЗ. Комиссия «Кодекс Алиментариус». Руководство по процедуре. 2013. – 236с.

7. Цуканов М.Ф., Соколов В.Д., Черноморец А.Б.,

Широкожухов В.В., Прокопенко С.Т., Липатов И.Б. Методология обеспечения питания человека. Принципы энергетической, пластической, энзиматической и биотической адекватности питания современного человека / Учебное пособие. СПб.: Санкт-Петербургский государственный экономический университет, 2015. – с. 7–39.

8. Боровкова Ю.И. Культура питания как форма физической культуры // Вестник научного общества студентов, аспирантов и молодых ученых. – Комсомольск н/А: Амурский гуманитарно-педагогический государственный университет. – №: 2 . – 2017. – с. 38–45.

9. Батурина В.В. Основы рационального питания // Образование и наука без границ: социально-гуманитарные науки. – Орел: Орловский государственный университет экономики и торговли. – №: 5. – 2016. – 147–149 с.

10. WHO. Guideline: Sodium intake for adults and children. – Geneva, 2012. – URL: https://www.who.int/publications/i/item/9789241504836 (дата обращения: 03.04.2025). – Текст: электронный.

11. WHO. Guideline: potassium intake for adults and children. – Geneva, 2012. – URL: https://www.who.int/publications/i/item/9789241504829 (дата обращения: 03.04.2025). – Текст: электронный.

12. WHO. Draft WHO Guidelines: Saturated fatty acid and trans-fatty intake for adults and children. – Geneva, 2018. – Текст: электронный. URL: https://www.who.int/publications/i/item/9789240073630 (дата обращения: 03.04.2025).

Appendices

Appendix 1

Equation for calculating the value of the basal metabolic rate (BMR) taking into account body weight (BM)

Age range (years)	Basal Metabolic Rate (BMR) (kcal/day)
Men	
0–3	60.9 x BM – 54
3–10	22.7 x BM + 495
10–18	17.5 x BM + 651
18–30	15.3 x BM + 679
30–60	11.6 x BM + 879
60 and older	13.5 x BM + 487
Women	
0–3	61.0 x BM - 51
3–10	22.5 x BM + 499
10–18	12.2 x BM + 746
18–30	14.7 x BM + 496
30–60	8.7 x BM + 829
60 and older	10.5 x BM + 596

Appendix 2

Average values and ranges of desirable body weight according to height in adults

Height without shoes (m)	men body weight (kg)			women body weight (kg)		
	desired average value	desired weight range	obesity	desired average value	desired weight range	obesity
1.45				46.0	42-53	64
1.48				46.5	42-54	65
1.50				47	43-54	66
1.52				48.5	44-57	68
1.54				49.5	44-58	70
1.56				50.4	45-58	70
1.58	55.8	51-64	77	51.3	46-59	71
1.60	57.7	52-65	78	52.6	48-61	73
1.62	58.6	55-66	79	54.0	49-62	74
1.64	59.6	54-67	80	55.4	50-64	77
1.66	60.6	55-69	83	56.8	51-65	78
1.68	61.7	56-71	85	58.1	52-66	79
1.70	63.5	58-73	88	60.0	53-67	80
1.72	66.5	59-74	89	61.3	55-69	83
1.74	66.5	60-75	90	62.6	56-70	84
1.76	68.0	62-77	92	64.0	58-72	86
1.78	69.0	64-79	95	65.3	59-74	89
1.80	71.0	65-80	96			
1.82	72.6	66-82	98			
1.84	74.2	67-84	101			
1.86	75.8	69-86	103			
1.88	77.6	71-88	106			
1.90	79.3	73-90	108			
1.92	81.0	75-93	112			
ИМТ	22.0	21.1-25.0	30.0	20.8	18.7-23.8	28.6

Appendix 3

Scheme for compiling a daily chronogram and calculating energy expenditure for various types of activities

Type of activity		Duration in min	Energy expenditure (including basal metabolic rate)	
			kcal/kg x min	Calculation of energy expenditure (kcal/kg x min) BM time in min
1. Class time				
Practical classes:				
a) laboratory			0.0360	
b) seminars			0.0250	
c) seminar and laboratory			0.0300	
d) in clinical departments therapeutic profile			0.0260	
e) surgical profile			0.0266	
Lectures			0.0243	
Breaks			0.0258	
Extracurricular time				
Preparation for classes			0.0250	
Gathering for classes			0.0450	
Road:				
a) walking on asphalt road / 4-5 km per hour /			0.0597	
b) driving			0.0267	
Homework:				
a) work on a personal subsidiary farm				
b) care of premises, furniture, household appliances, etc.			0.0757	
c) purchase of goods, food			0.0402	
d) child care			0.0450	
d) hand washing			0.0360	
e) washing dishes			0.0511	
Self-service			0.0313	
making the bed				
eating (sitting)			0.0329	
washing up to the waist			0.0236	
shower			0.0504	
cleaning trousers			0.0570	
cleaning clothes on oneself and shoes			0.0317	
putting on and undressing shoes and clothes			0.0493	
			0.0264	

End of Appendix 3

Scheme for compiling a daily chronogram and calculating energy expenditure for various types of activities

Free time				
Rest:			0.0264	
a) standing			0.0229	
b) sitting			0.0183	
c) lying down without sleep				
Cultural events:			0.0230	
a) silent reading			0.0250	
b) reading aloud			0.0596	
c) dancing (waltz)			0.0290	
d) singing			0.0242	
d) playing chess				
Community work			0.0490	
(agitator)			0.0690	
Sundays (cleaning the territory)				
Physical education and sports:			0.0648	
a) morning exercises				
b) running at a speed			0.1357	
8 km/h			0.1780	
180 m/min			0.3200	
320 m/min				
c) gymnastics:			0.0845	
Floor exercises			0.1280	
training on apparatus			0.0110	
d) rowing			0.1285	
d) cycling (13-25 km/h)			0.1071	
e) skating				
g) skiing:			0.0546	
preparing skis			0.2086	
cross-country travel			0.1707	
studies			0.1190	
h) swimming			0.0893	
i) shooting exercises with weapons				
Work in production:			0.0405	
light physical work			0.0690	
moderate work			0.1072	
heavy physical work			0.0155	
Sleep				

Appendix 4

Daily requirement for substances and energy of the adult working population

Group	Coefficient	Age	Energy (kcal)	Proteins (g)		Fats	Carbohydrates	Minerals (mg)				
				total	Inc.animals			calcium	phosphorus	magnesium	iron	iodine
MEN												
I	1.4	18–29	2450	72	40	81	358	800	1200	400	10	0,15
		30–39	2300	68	37	77	335					
		40–59	2100	65	36	70	303					
II	1.6	18–29	2800	80	44	93	411	800	1200	400	10	0,15
		30–39	2650	77	42	88	387					
		40–59	2500	72	40	83	366					
III	1.9	18–29	3300	94	52	110	484	800	1200	400	10	0,15
		30–39	3150	89	49	105	462					
		40–59	2950	84	46	98	432					
IV	2.2	18–29	3850	108	59	128	566	800	1200	400	10	0,15
		30–39	3600	102	56	120	528					
		40–59	3400	96	53	113	499					
V	2.5	18–29	4200	117	64	154	586	800	1200	400	10	0,15
		30–39	3950	111	61	144	550					
		40–59	3750	104	57	137	524					
WOMEN												
I	1.4	18–29	2000	61	34	67	289	800	1200	400	18	0,15
		30–39	1900	59	33	63	274					
		40–59	1800	58	32	60	257					
II	1.6	18–29	2200	66	36	73	318	800	1200	400	18	0,15
		30–39	2150	65	36	72	311					
		40–59	2100	63	35	70	305					
III	1.9	18–29	2600	76	42	87	378	800	1200	400	18	0,15
		30–39	2550	74	41	85	372					
		40–59	2500	72	40	83	366					
IV	2.2	18–29	3050	87	48	102	462	800	1200	400	18	0,15
		30–39	2950	84	46	98	432					
		40–59	2850	82	45	95	417					

Appendix 5

Chemical composition and energy value of the diet

List of products	Gross weight g	Mass of waste	Net weight	Organic composition, g Proteins Fats Animal Plant. Animal Plant.				Total carbohydrates /g/	Vitamins C, B1, A	Minerals, mg				Energy value Kcal
				Proteins		Fats				Ca	P	Mq	Fe	
				Animal	Plant	Animal	Plant							
Breakfast:														
Total:														
Lunch:														
Total:														
Afternoon snack:														
Total:														
Dinner:														
Total:														
Daily dietary indicators														

Appendix 6

Nutrition analysis summary table.

№ п/п	Indicators	Recommended standards	quantity in the diet	Correspondence	Excess	Flaw
1	Total caloric content, kcal					
2	Proteins, g					
	of which animals, g					
	animals in /%/					
3	Fats, g					
	of which vegetable, g					
	vegetable in /%/					
4	Carbohydrates, g					
5	Ratio between B:F:U					
6	Vitamins, mg					
	A					
	B_1					
	C					
7	Mineral elements, mg					
	Calcium					
	Phosphorus					
	Magnesium					
	Iron					
	Ratio Ca: P: Mq					
8	Diet					
	Caloric content, %					
	Breakfast					
	Lunch					
	Afternoon snack					
	Dinner					

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HYGIENIC REQUIREMENTS TO CONSTRUCTING A RATIONAL NUTRITION. METHODS OF DETERMINING THE BODY'S NEEDS FOR ENERGY AND NUTRIENTS

Educational manual

Signed for use XX.XX.2025.
Headset «Times New Roman».

Kazan Federal University