

**МИНИСТЕРСТВО ЗДРАВООХРАНЕНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ**  
**УЧРЕЖДЕНИЕ ОБРАЗОВАНИЯ**  
**«ГОМЕЛЬСКИЙ ГОСУДАРСТВЕННЫЙ МЕДИЦИНСКИЙ УНИВЕРСИТЕТ»**

**Department of the General Hygiene, Ecology and Radiation Medicine**

# **HYGIENE OF THE NUTRITION**

Учебно-методическое пособие  
для студентов 2 курса  
факультета по подготовке специалистов  
для зарубежных стран

**Гомель 2007**

УДК 613.2  
ББК 51.23  
Г 46

**Составитель:** Золотарева А. В.

**Рецензент:** кандидат медицинских наук, доцент кафедры общей гигиены, экологии и радиационной медицины Гомельского государственного медицинского университета **Мамчиц Л. П.**

**Г 46**      **Hygiene of the Nutrition = Гигиена питания:** уч.-метод. пособие для студентов 2 курса факультета по подготовке специалистов для зарубежных стран / сост.: А. В. Золотарева. — Гомель: Учреждение образования «Гомельский государственный медицинский университет», 2007. — 40 с. ISBN 978-985-506-048-3

Настоящее учебно-методическое пособие предназначено для студентов медицинских вузов, обучающихся на английском языке. Учебное пособие состоит из четырех взаимосвязанных занятий и посвящено изучению гигиены питания, рассчитано на 16 часов практических занятий.

Учебно-методическое пособие соответствует требованиям высшей школы.

Утверждено и рекомендовано к изданию Центральным учебным научно-методическим советом учреждения образования «Гомельский государственный медицинский университет» 1 июня 2007 г., протокол № 4.

**УДК 613.2**  
**ББК 51.23**

ISBN 978-985-506-048-3

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## **TOPIC 1: THE HYGIENIC ESTIMATION OF NUTRITION ADEQUACY**

**Total time:** 4 hours.

**URGENCY:** the Food plays the important role in formation of health.

The adequate balanced nutrition causes normal growth and development of an organism, adaptation and physical workability.

Therefore the control over nutrition of the population is considered as one from the important problems of doctors-experts of sanitary-and-epidemiologic establishments.

The control over nutrition includes research of an actual nutrition and the status of nutrition — states of health in connection with character of nutrition. Rational nutrition is a duly and optimal satisfaction needs of an organism for nutrients and energy. Studying of an actual nutrition of the organized collectives it is spent with the purpose of definition of chemical compound conformity and energy values of diets the established specification of a nutrition and physiologists needs for nutrients and energy, a diet to biological rhythms, age and health state; duly revealing of requirements infringements to a balanced diet and the prevention of elementary frustration and the illnesses connected to them, reduction of specific and nonspecific immunity.

### **THE PURPOSE**

To be able to prove conformity of diet structure to individual organism needs in energy and some food substances.

### **TASKS**

To learn students to methods of definition of organism energy inputs and need in food substances.

### **VOLUME OF INDEPENDENT WORK OF STUDENTS**

1. Each student is offered to determine the energy-expense using the data of daily timing, using tables of the charge energy at various kinds of activity.

2. To make a diet for one day, to calculate energy value and qualitative structure of a diet with received menu.

3. To assess a diet.

4. To compare parameters of the qualitative and quantitative nutrition with standard.

5. To give recommendations on nutrition correction.

### **REQUIREMENTS TO AN INITIAL LEVEL OF STUDENT'S KNOWLEDGE**

It is necessary to repeat from:

1) Normal physiology — «Physiological bases of nutrition», «Methods of definitions of organism energy-expense», «Metabolism», «Energy value of food substances»;

2) Bioinorganic and bioorganic chemistry — «The chemical compound food products and their value»;

3) Biochemistry — «Proteins, fats, carbohydrates, vitamins, water and mineral salts metabolism, their biological role and value in a human nutrition», «General metabolism ways».

### **CONTROL QUESTIONS FROM RELATED SUBJECTS**

1. To list typical infringements of a metabolism owing to infringements a nutrition.
2. Role of food substances in sustenance of organism functions.
3. Methods direct and indirect calorimetry.
4. To give the characteristic of chemical value of different groups of food products.

### **THE BASIC EDUCATIONAL QUESTIONS**

1. Nutrition as a social-and-hygienic problem.
2. Biological essence of a nutrition problem.
3. Hygienic requirements to nutrition. Concept of rational and balanced nutrition.
4. Chemical compound and nutritional value of proteins, fats, carbohydrates, role of vitamins and mineral substances.
5. Physiological norms of nutrition for various population groups.
6. Hygienic principles of balanced diet construction.
7. The sanitary-and-hygienic control and an estimation of population nutrition (methods of an estimation of nutrition adequacy).
8. Substantiation of a diet.

### **AUXILIARY MATERIALS**

Scientific basis of the balanced nutrition organization of human independently of age, sex, a health state and professional work are the common physiology-and-hygienic requirements to:

1) to a diet — energy value and qualitative structure, equation of nutrients, comprehensibility and digestibility, organoleptic properties and a variety, a saturation, structure of dishes and a combination of foodstuff, sanitary-and-epidemic impeccability;

2) to a diet regimen — hours and duration of food intake, frequency rate and intervals between them, queue of dishes intake, diet distribution on food intake (energy value, structure, volume, weight);

3) to conditions for food intake — an interior of a dining room, table appointments, microclimatic comfort, etc.

### **Methods of research of a condition of a nutrition of the population**

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Biographical		Biometric
Answering-and-weight		Physiological
Weight		Biochemical
Statistical		Clinical
Laboratory		Epidemiological
Inspection		Analysis
Budget		Energometric
Balance		

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Taking into account specific goals, tasks and conditions of research, and also advantages of this or that method, can be applied a little methods, their various forms and combinations. At carrying out of biographical inspection of a nutrition it is necessary to have in view of, that registration of the data interesting the researcher concerning. Consumption of food and diet, should not exceed 1–2 days, differently (otherwise) their reliability is reduced.

The volumetric-and-weight method enables to check quantitative side of nutrition. Are defined: volume and weight of ready dishes, uniformity of a portion, the rests of not eaten food. The weight of dishes should correspond to norms of an output. For a rough establishment of nutritional value of the first dishes it is recommended to filter 2–3 portions taken in a lunch hall, and a dense part to weigh. At observance of rules of preparation of food and uniform distribution the weight of a rich part should make from 40 up to 50% of weight of a dish as a whole.

Actual output of the second dishes and uniformity meet and fishes portioning, is checked by weighing not less than 10 dishes (portions), prepared to distribution, a maximal permissible deviation  $\pm 3\%$  of dish weight. A deviation in to weight of portions of oil, sugar, chocolate, smoked products and other products, not undergone to special culinary processing, it is not allowed.

The studying of an actual nutrition based on the account of consumption foodstuff, it is possible to carry out by registration and the data analysis about the food stuff consumption. In case of studying nutrition of numerous population groups is used a method of balance researches, family nutrition — a method of budget researches.

The estimation of an actual nutrition of the organized collectives can be carried out with the help of a method of the analysis monthly or annual reports about food stuff consumption. Further according to consumption is calculated chemical compound and energy value of a diet. Other way is selective studying of nutrition on materials of the menu-apportionment.

### **Method of the hygienic analysis of a menu - apportionment**

It is possible to recommend the following volume of menu-apportionment sample: for the characteristic of a nutrition as a whole for previous year - not less, than for 72–80 days; for the characteristic of a nutrition in seasons — during 20–30 days of each season (winter-spring and summer-autumn). To avoid casual days and more full to estimate a diets variety on days, it is desirable to analyses the menu - apportionment for some days successively (7 days in each month) or every regular intervals (in 1–2 days).

Value of inspection considerably rises if statistical processing of a menu-apportionment is accompanied by chemical research of a diet.

The important value for a hygienic estimation and correction actual nutrition has research of daily energy expenses of an organism. There are a number of methods for general energy expenses definition: direct, indirect energometry and its ver-

sions (respiratory ergometry, chronometric-and-tabular, alimentary ergometry). Direct and respiratory ergometry methods are used seldom, as for their application the complex equipment is required. The chronometric-and-tabular method is simple, popular, but it is insufficiently reliable.

### **Method of alimentary ergometry**

The method is based on proportional body weight dependence from energy expenses and energy value of consumed food. The healthy person is in a condition of energy balance at which all spent energy will be filled due to food energy substances. This equality is provided with systems of physiological regulation and shown in keeping constant body weight. Hence, if body weight is kept in constant during more or less long time intervals (10–15 day) caloric content of the eaten food corresponds to the general energy expenses of organism. By special researches it was established, that everyone kg of increasing (loss) of body weight it is equivalent 6800 kcal superfluous (not enough) consumed food.

At an estimation of nutrition it is necessary to use recommended physiological norms of nutrition. Sizes contained in them carry group character also concern to groups of persons with identical characteristics: sex, age, body weight, the energy expenses level. Practice has shown connections of energy expenses with belonging to profession. Was required introduction objective physiological criterion — the ratio of the general energy expenses to basic metabolism. Received the coefficient of physical activity forms groups with identical energy expenses, where various trades and non-professional kinds of activity can be referred.

### **Algorithm of the estimation of individual nutrition adequacy by chronometric-and-tabular method**

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Timing of time of various kinds of individual activity for one day.

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Drawing up day chronogram.

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Calculation of energy inputs at various kinds of activity and for day as a whole.

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Calculation of size of not taken into account (of not discounted) energy consumption (5% from the general energy expenses for various kinds of activity).

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Calculation of energy consumption for specifically — dynamic nutrition action (10–15% from the basic metabolism).

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Calculation of daily energy needs and requirements in separate food substances (it is established on the data physiological norms).

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Definition energy values and nutritive structure daily ration in view of natural losses of the basic food substances, vitamins and mineral substances

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The analysis and estimation received data in the summary table

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Explanation of result conclusions and the proved recommendations on energy values and nutritive structure of a diet

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### Materials for the control over mastering of a theme

#### The report of independent work

#### The card-questionnaire of studying of individual nutrition adequacy (fill up tables 1, 2, 3)

Name Age Sex Date of filling Harmful habits — smoke (no, yes)

If smokes — how many: a pack in day, more than pack, half of pack (to under line) — whether is used alcoholic drinks (no, yes).

If is used — what, how many, as often. Life conditions, presence of public service, training by sport (a kind, regularity, duration).

Table 1 — The table of daily timing of a energy consumption of the student

N	Kind of activity	Duration	Energy inputs	
			Kcal*min/kg	Final, kcal

Table 2 — The table of the maintenance of the basic food substances and energy value a daily diet

Name of dish	Weight, g	Organic substances				Energy value	Mineral substances				Vitamins, mg								
		proteins		fats			Ca	P	Mg	Fe	A	B <sub>1</sub>	B <sub>2</sub>	C					
		animal	plant	animal	plant														

Table 3 — The table of an estimation of nutrition adequacy

Estimated parameters	Unit of measurement	Actual	On physiological norms
1. Caloric content of a diet	Kcal		
2. The basic metabolism	Kcal		
3. Specifically dynamic food action	Kcal		
4. Energy expenses on all kinds of activity	Kcal		
5. Total energy-expenses	Kcal		
6. Proteins	g		
• From them animals origin	g		
7. Fats			
• From them plant origin	g		
8. Carbohydrates	g		
9. Mineral salts	g		
• Ca	mg		
• P	mg		
• Mg	mg		
• Fe	mg		
10. Vitamins			
• A			
• B1			
• B2			
• C			
• PP			
11. Caloric content due to proteins	Kcal (%)		
12. Caloric content due to fats	Kcal (%)		
13. Caloric content due to carbohydrates	Kcal (%)		
14. Ratio P : F : C	1 : 1 : 4		
15. Ratio Ca : P	1 : 1,5		
16. Ratio Ca : Mg	1 : 0,5		
17. Caloric content of a breakfast	%		
18. Caloric content of a dinner	%		
19. Caloric content of a supper	%		

### Conclusion and recommendations



## **TOPIC 2: THE HYGIENIC ESTIMATION OF THE NUTRITION STATUS**

**Total time:** 4 hours

### **URGENCY OF TOPIC**

Sanitary inspection of nutrition includes research both an actual nutrition, and the nutrition status. Studying of the nutrition status has the important value for early revealing the pre-nosological conditions caused by an inadequate and unbalanced nutrition, with the purpose of preventive maintenance of alimentary disturbances, increase of immunity, intellectual and physical workability. At detection of attributes of infringement of the nutrition status (health state) actions on its correction are carried out, first of all, by rationalization of a nutrition.

### **THE PURPOSE**

To learn to make the motivated conclusion about the nutrition status and to give hygienic recommendations for approximation of an actual nutrition to physiological needs and also for diet normalization.

### **PROBLEMS**

To study the nutrition status using available methods.

### **VOLUME OF INDEPENDENT WORK**

Using a teaching material to carry out hygienic diagnostics of nutrition status individually by each student.

### **THE BASIC EDUCATIONAL QUESTIONS**

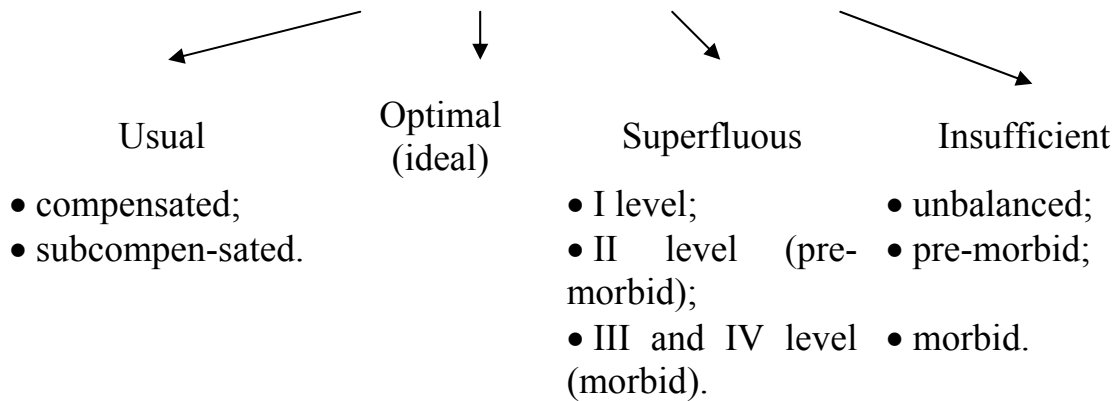
1. Classification of nutritional status.
2. Differential diagnostics of a nutrition condition with the account indexes:
  - a) Structures;
  - b) Functions;
  - c) Adaptable reserves;
  - d) Constitutional typing.
3. Attributes and illnesses of nutrition insufficiency, parameters of vitamin adequacy.
4. Technique of nutrition status definition, self-descriptiveness of indexes.
5. Energy and nutrients value of some basic groups of products.

### **AUXILIARY MATERIALS OF THEME**

*The human nutritional status is a definite health condition, which has developed under influence of a previous actual nutrition and genetically determined features of a nutrients metabolism.*

*Criteria of nutrition status* — structure, physiologic functions and adaptable reserves of organism.

## **CLASSIFICATION OF NUTRITION STATUS**



Differential diagnostics of a nutrition condition is carried out on the basis of the descriptive characteristic, the date physiological condition, physiological and biochemical parameters of homeostasis. The important value has diet parameters and the data of clinical observations.

Taking into account, that influence of an actual nutrition on formation of the nutrition status to a certain extent depends from genetic features of the person, interpretation of research results is possible only at the account of the data constitutional typing (table 1).

Are selected 4 basic kinds of the constitution: **asthenoid, thoracic, muscular, digestive, and also uncertain.**

Table 1 — Somatoscopic characteristic of basic constitution kinds

Constitution kinds	Form of thorax	Epigastric angle	Form of legs	Form of abdomen	Development of a skeleton (marks)**	Development of muscles (marks)***	Adipopexis (marks)****
Asthenoid	Flat	< 90	O-shaped	Hollow	1	1	1
Thoracic	Cylindrical	90 < 90	O,X,H-shaped	Direct	1–2	1–2	1–2
Muscular	Cylindrical	90 > 90	O,X,H-shaped	Direct	2–3	2–3	1–2
Digestive	Conical	> 90	X-shaped	Convex	2–3	2–3	2–3

\* — Shape of legs.

\*\* — Development of a skeleton.

It is necessary to mark skeleton massiveness, being based on a relief and the sizes of large joints (elbow, knee, radiocarpal). Distinguish three degrees: thin (1 point), average (2 points), massive (3 points).

\*\*\* — Development of muscles.

At an estimation of muscles it is necessary to consider all muscles as a whole, instead of one any segment.

The estimation of muscles is made in two directions: quantitative development of a muscular layer, a qualitative condition of muscles (a tone, elasticity).

Distinguish three degrees of development of muscles: small (1 point), average (2 points), good (3 points). It is quite enough to state the general estimation of muscles, taking into account and its quantitative development, and a degree of elasticity (tonus).

\*\*\*\* — Adipopexis — development of fatty tissue.

Distinguish three degrees of development adipopexis: small (1 point) — clearly acts a bone relief (belt (zone), scoop, edges); average (2 points) — the smoothed bone relief is not clearly expressed; big (3 points) — the smoothed bone relief, roundness of contours.

### **METHOD OF DEFINITION THE MAINTENANCE OF FAT AND LEAN (ACTIVE) BODY WEIGHT**

- An increase in weight in relation to height does not always mean fatness or obesity if the increase in weight is due to muscle mass as in body-builders. Degree of fatness (adiposity) correlates better with the increased risks of diseases. Skin fold thickness is often used to measure this adiposity.

- Measurement of skin fold thickness requires special calipers. Various areas of the body have been suggested as suitable for measuring skin fold thickness, including back of the arm over the triceps, below the scapulae at the back, and at the supra-iliac region of the anterior abdominal wall.

- Skin fold thickness represents peripheral fatness or adiposity. In recent years attention is focused more on abdominal (also called central or visceral) adiposity (see «Waist Circumference» and «Waist-Hip-Ratio» below).

### **WAIST CIRCUMFERENCE (WC)**

- Adipose tissue (fat) distributed centrally within the abdomen and among the viscera is also a predictor of cardiovascular, cerebrovascular, and metabolic (diabetes & hyperlipidemia) diseases. Among adult Asians, a waist circumference > 90 cm in men and > 80 cm in women increase further the risk of these diseases associated with an increase in BMI (see Table to the right).

- Measure the waist circumference of your fellow student according to the method recommended by the World Health Organization:

1. The subject should be lightly dressed; measurement should not be made through thick or bulky clothing;

2. Position the subject upright with feet 25–30 cm apart and weight evenly distributed;

3. Sit yourself by the subject comfortable on a chair;

4. Fit a tape measure snugly around the abdominal girth without compressing soft tissue and measure the waist circumference to the nearest 0,1 cm in a horizontal plane midway between the inferior costal margin and the iliac crest.

5. Use the BMI and WC of your fellow student to determine his risk for cardiovascular, cerebrovascular, and metabolic (diabetes & hyperlipidemia) disease.

Waist Circumference	Risk	Waist Circumference
>90cm (men)		≥90 cm (men)
<80 cm (women)		≥80 cm (women)
BMI	Very severely increased	BMI
≥30	Severely increased	25-29,9
25-29,9	Moderately increased	23-24,9
23-24,9	Mildly increased	18,5-22,9
18,5-22,9	Average	<18,5
<18,5	Low	

For definition of the fat maintenance in an organism measure thickness skin-fatty fold. And hypodermic cellular tissue is recommended to measure thickness of a double skin layer with the help thickness meter in three points:

- a) at the left on medium axillary lines at a mammilla level;
- b) on a belly wall in iliac areas on parasternal lines (5 cm from umbilicus);
- c) under the bottom corner right scapula. Thus in first two points the skin with hypodermic fatty tissue is grasped by fingers in a horizontal direction, under a corner scapula — in vertical.

Replacement vernier calipers or is supposed by a transparent ruler.

### ***STAGES OF CALCULATION OF FAT IN BODY AND LEAN (ACTIVE) WEIGHT***

#### **1. a) Calculation of absolute fat quantity:**

$$X = M \times C \times 0,0632,$$

where X — quantity of fat, g;

M — average arithmetic thickness skin-fatty fold in three points, mm;

C — the area of a surface of a body, cm<sup>2</sup>;

0,0632 — empirical factor.

#### **b) Calculation of the body surface area, cm<sup>2</sup>:**

$$C = 134 \times m + 52,4 \times P,$$

where C — the body surface area, cm<sup>2</sup>;

m — body weight, kg;

P — height standing, cm.

## 2. Calculation of the relative maintenance of fat

$$Y = X/m \times 100\%,$$

where Y — the maintenance of body fat, %;

X — quantity of body fat, g;

m — body weight, g.

## 3. Calculation of lean (active) body weight, g;

$$TMT = m - X$$

where TMT — quantity of lean (active) body weight, g;

m — body weight, g;

X — quantity of body fat, g.

**Skinfold thickness** is estimated on scale:

Good nutrition condition — 16–20 mm;

Satisfactory — 11–15 mm;

Decreased — 7–11 mm;

Exhaustion — < 6 mm;

Obesity — > 20 mm.

With increasing fat content in body from minimal means is observed improvement all investigated function parameters, then comes relative their stabilization, but at more increasing-degradation, all the more expressed than fat content in organism more.

### Waist-Hip Ratio (WHR)

• The Waist-Hip Ratio of a person is obtained by dividing his «Waist circumference» by his «Hip circumference»:

$$WHR = \text{Waist circumference (cm)} / \text{Hip circumference (cm)}$$

• Hip circumference can be measured around the pelvis at the point of maximal protrusion of the buttocks.

• WHR is considered to be a ratio between fat stored centrally inside the abdomen (waist circumference) and fat stored peripherally (hip circumference). A WHR > 1.0 in European men or 0.85 in European women is associated with increased risk of ischemic heart disease, stroke, and diabetes. These limits have not been determined for Chinese. Mid-Arm Circumference (MAC) and Mid-Arm Muscle Circumference.

• The **Mid-Arm Circumference (MAC)** is the circumference of the non-dominant arm midway between the shoulder and the elbow. Assuming the mid-arm muscle mass is a cylinder surrounded by a circumferential layer of skin fold, the Mid-Arm Muscle Circumference can be calculated as follows: (There is no need to memorize the formula; just understand the principle.)

$$MAMC = MAC - (\pi \cdot \text{skin fold thickness})$$

- Mid-Arm Muscle Circumference is considered an index of muscle mass and caloric adequacy. Malnutrition can cause muscle wasting and a decrease in muscle circumference. The calculation of Mid-Arm Muscle Circumference is based on the erroneous assumptions that the muscles are completely round and that bone mass is negligible. Although it may be of interest to nutrition experts, it is not popular among primary care physicians.

Somatoscopy parameters allow to test infringements of a nutrition authentically enough: attributes of protein-energy, vitamin and mineral insufficiency.

### **RESEARCHES OF CAPILLARIES RESISTENCY OF SKIN (CRS)**

CRS depends on provision of an organism by ascorbic acid and rutin which participate in regulation colloid conditions of intercellular substances.

This parameter is estimated on occurrence of haemorrhages on the limited site of a skin in a place of mechanical influence (creation of superfluous or negative pressure).

On the top third of shoulder impose tonometer, creating pressure 200 mm Hg within 3 minutes. CRS are estimated on a site graduated weight bearing on a skin (under a cuff). Haemorrhages count up with the help of a magnifier. If to this prevents hyperemia expediently site of research slightly to squeeze subject glass: on anemic to a skin hemorrhage acts more distinctly.

CRS is estimated on a five-mark scale: the first degree — up to 5, the second — from 6 up to 15, the third degree — up to 30, the fourth degree — more than 30 haemorrhages; 5 degree — number of haemorrhages defy in to calculation.

At practically healthy people the first and second degrees of capillaries skin resistency are usually registered.

### **DEFINITION OF TIME DARK ADAPTATIONS**

Increase of light sensitivity of the visual analyzer in conditions of low light exposure substantially depends on the speed of regeneration of visual purple proceeding with participation of vitamins A and B<sub>2</sub>.

At insufficient maintenance of an organism by retinol and riboflavin duration dark adaptation grows down to loss of ability to see at twilight illumination.

### **ESTIMATION OF A PHYSICAL CONDITION**

*Physical condition* is the complex parameter describing a health state of an organism. It based on the data of physical development and physical readiness.

*Somatometry method* is based on research and an estimation of sizes morphological parameters.

*Statural-weight value (anthropometrical) indexes* characterize means of several anthropometrical parameters as one dimensionless size.

- With practice it is not difficult to classify an individual as emaciated, slender (thin), normal, plump (overweight), or obese.

- Emaciation is a condition in which weight loss is extreme and is accompanied by skeletal muscle wasting. As a consequence, the affected individual's cheeks are sunken and bony landmarks of his maxilla, major joints, ribs, scapulae, and pelvis are unusually prominent.

- Morbid obesity is a condition in which an individual weighs two or more times his ideal weight.

### **Body weight and height**

- Body weight, particularly in relation to height, is commonly used as an indicator of general nutrition status. Underweight can be due to inadequate food intake, poor absorption or utilization, or unbalanced and excessive usage of energy by the body (as when the thyroid gland is overactive in hyperthyroidism). In the absence of disease, excess body weight usually reflects obesity (an increase in the amount of fat tissue) from excessive food intake, except in body builders who have a high muscle mass. More than 5% change in body weight, particularly recent and sudden in onset (e.g., over the last month), indicates either change in dietary intake or underlying illness.

- To measure the weight and height of a patient during routine examination is important both for their immediate value and for future reference. In the doctor's office or in the outpatient clinic, the weight of a patient should be obtained with him wearing only normal indoor clothing and without shoes. In an inpatient hospital setting, a patient should be weighed in hospital pajama or gown, again without shoes. To measure height, a patient should be standing upright, arms resting by his side, and without shoes.

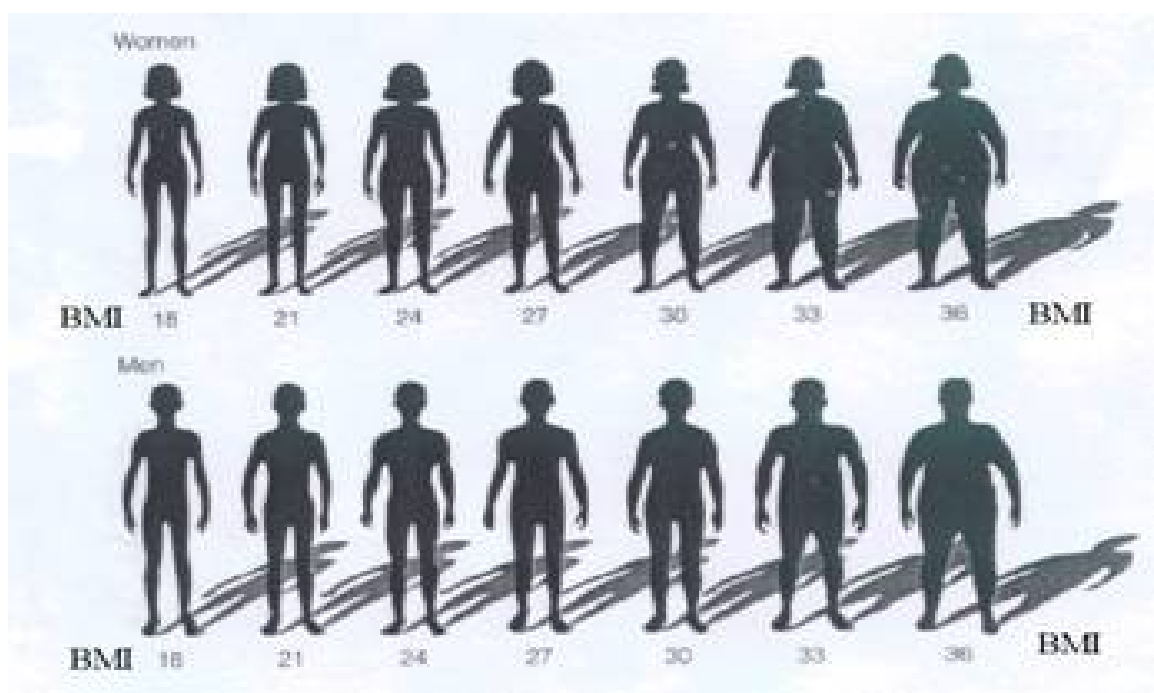
- To determine whether a patient's weight is normal, one can go to tables of ideal weight in relation to height and gender. Different version of these tables exists. Some of these tables will take into account the person's frame or body build (small, medium, or large). However, body frame (body build) cannot be measured and must be derived visually.

A visual assessment of the patient's general appearance can provide a relatively accurate assessment of his general nutrition status. According to the Canadian Dietetic Association, the silhouette (body shape) of women and men are related to their Body Mass Index or BMI (see below) as shown in the accompanying picture:

$$\text{Broka's Index} = \frac{\text{Body mass (kg)}}{\text{Height - 100 (cm)}}$$

Optimal mean this parameter is equal 1.

**Ketle's Index (or Body Mass Index) =  $M / H^2$ ,**  
M — body mass, kg; P — height, (standing), m.



- In adult Asians, a person is considered underweight if his BMI is  $<18,5 \text{ kg/m}^2$ ; he is considered normal if his BMI is  $18,5$  to  $22,9 \text{ kg/m}^2$ ; he is considered overweight if his BMI is  $> 23 \text{ kg/m}^2$ ; he is considered obese if his BMI is  $> 25 \text{ kg/m}^2$ .

- There is a positive relationship between BMI and risks of cardiovascular, cerebrovascular, and metabolic (diabetes mellitus & hyperlipidemia) diseases; these risks rise appreciably when the BMI is above  $23 \text{ kg/m}^2$  (see «Waist Circumference» and «Waist-Hip-Ratio»).

Physical readiness is determined by results of, received at performance of some the exercises describing a level of development of the basic qualities of impellent activity: endurance, force, speed.

For an estimation of endurance are examined results of run within 6 minutes, and long-distance race 1000, 1500, 3000 m (depending on a health state, age and a sex). For an estimation of force use: pulling up on a crossbeam, bending of hands in an emphasis, for an estimation of speed-shuttle run, sprint (60, 100 m).

For an estimation of a functional condition of an organism, physical and intellectual workability are used various physiological and psycho-physiological methods.

## PHYSIOMETRICAL METHODS

**Dynamometry** — measurement of muscular hands force (separately right and left) is made by a manual dynamometer of usual type. The greatest effect is reached by gradual (without jerks) compression of a dynamometer only in a fist (by reduction of forearm muscles). At test is necessary to stand directly, freely allocating hands a little sideways and forward (don't bend in an elbow, don't press to a hip). 2–3 measurements are made, the greatest result (in kg) is registered.



On the basis of the received data «**Force index**» (FI) is calculated.

$$\text{FI} = \frac{\text{Muscular Force of right hand (kg)} \times 100\%}{\text{Body Weight (kg)}}$$

Norms for female — 35–40; for male — 70–75.

**The maximal muscular endurance** is determined with the help of a dynamometer on deduction of the maximal muscular effort within 1 minute.

Are fixed size of effort in beginning ( $P_1$ ) and in end ( $P_2$ ) of minute.

$$\text{Factor of endurance} = \frac{P_2 (\text{kg})}{P_1 (\text{kg})} \times 100 \%$$

**Spirometry** — definition of vital capacity of lung (VCL) is made by means of an air or water spirometer. Surveyed do the maximal breath barks, having detained breathe, densely clasps lips a mouthpiece and, not hurrying up, blows all air in a tube, trying to make the maximal exhalation. It is necessary that all exhaled air went to a tube (surveyed can clamp a nose by a hand). Research is made 2-3 times, the maximal result (in l) enters the name.

On the basis of the received data it is possible to calculate «**Vital index**» (VI).

$$\text{VI} = \frac{\text{VCL (ml)}}{\text{Body Weight (kg)}}$$

Norms for women more then 50 ml/kg; for men — more then 60 ml/kg.

### PHYSIOLOGICAL METHODS

**Test Ruffie** — is applied to an estimation of heart workability to physical loading (30 knee-bends for 1 mines). Results are estimated on change of frequency of intimate reductions. At surveyed pulse for 15 sec is counted up. ( $P_1$ ) after a 5-minute quiet condition (laying on a back), then after knee-bends (30 knee-bends in one minute, under the account of the researcher) count up pulse for the first 15 sec ( $P_2$ ) and the last 15 sec ( $P_3$ ) the first minute after the finishing of loading.

*The parameter of heart activity (PHA) is calculated by the formula:*

$$\text{PHA} = \frac{4 \times (P_1 + P_2 + P_3) - 200}{10}$$

*Estimation PHA is conducted on four-mark system:*

*At PIA from 0,1 up to 5 — it is excellent.*

*From 5,1 up to 10 — it is good.*

*From 10,1 up to 15 — it is satisfactory.*

*From 15,1 up to 20 — it is bad.*

## TEST WITH BREATH-HOLDING

It is used for judgement about oxygen provision of an organism.

It allows to judge about reserves of the device oxygen provision of exchange needs of an organism. It characterizes stability to an anoxia also.

*Gench's Test* is applied at mass researches more often. At rest surveyed persons in a condition count up pulse for 30 sec. The probationer does three deep respiratory movements, then a breath — exhalation and holds the breath, having clamped by fingers a nose. Time of breath-holding is registered by a stop watch. After renewal of breath count up pulse for 30 sec.

*The test is estimated:*

— Durations of breath-holding (in sec) in four-mark system: an excellent condition — more than 50 sec., good — 30–50 sec., average 20–29 sec., bad — less than 20 sec.;

— **Parameter of reaction heart-vascular system (PR):**

$$\text{PR} = 100 \% - \left( \frac{\text{FP after breath-holding for 30 sek}}{\text{FP before breath-holding for 30 sek}} \times 100\% \right),$$

where PR — frequency of heart reductions.

The result is estimated on a scale: Excellent reaction > 25%, Good — 20–25%, Average — 15–19%, Bad — <15%.

— **Index of stability to hypoxia (ISH):**

$$\text{ISH} = \frac{\text{FP for 30 sec after breath-holding}}{\text{Time of breath-holding}}$$

Norm ISH is equal 1 and less. The value is less, the higher stability to hypoxia.

It is necessary to note, that normalization of parameters of adaptable reserves according to existing classification of the nutritional status is in a stage of development that complicates their use. Nevertheless, separate specifications are available, their connection with change of the nutritional status is established, that is why in a complex with other groups of parameters they can will be applied at its estimation.

## OTHER MEASUREMENTS

### **Adaptation potential**

For complex estimation health level and reveal possible adaptive disturbance is defined integral parameter, what characterize adaptive reserves of blood circulation system — *adaptation potential*.

$$AP=0,011 \cdot (PR)+0,014 \cdot (SP)+0,008 \cdot (DP)+0,009 \cdot (W)-0,009 \cdot (H)+0,014 \cdot (A)-0,27,$$

where AP — adaptation potential;  
 PR — pulse rate, bit/min;  
 SP — systolic pressure, mm mercury;  
 DP — diastolic pressure mm mercury;  
 W, kg — body mass, kg;  
 H, cm — height, cm;  
 A, year — age, years.

**Estimated result:** *satisfactory adaptation* — 2,20 and less — for male; 1,96 and less — for female; *tension of adaptation* — 2,21–2,43 — for male; 1,97–2,23 — for female; *unsatisfactory adaptation* and *adaptation breakdown* — 2,44 and more — for male; 2,24 and more — for female.

### **Studying of protein, vitamin and mineral deficiency in organism**

For nutrient adequacy estimation of an actual nutrition to organism needs is applied *the biochemical methods* of research giving the information about protein, mineral and vitamin organism condition.

#### **Parameter of protein nutrition:**

The level of protein nutrition is characterized *by a parameter of protein nutrition (PPN)*. PPN is ratio of size nitrogen of urea excretion to the general nitrogen of the urine, expressed in percentage. On M. N. Logatkin and V. I. Knjazkov, at an optimal and adequate protein nutrition PPN is equal 90%; at lowered, but completely compensated, *level of protein nutrition* PPN — not lower 80%, and at low and insufficient *protein nutrition* PPN is reduced up to 70% and is lower.

Organism provision *by mineral substances, including microelements, and water-soluble vitamins* is studied on renal excretion these substances and their metabolites.

The additional methods describing a degree of vitamin and mineral organism deficiency, have served *somatoscopic definition of microsymptoms of vitamin and mineral insufficiency*, and also *a method of capillaries resistency estimation*. Revealing of food insufficiency microsymptoms is carried out by estimation of a condition mucous membranes and skin, hair, nail plates with use of the diagnostic table. For the additional characteristic of C-vitamin organism provision definition of skin capillaries resistency was used. The given parameter is estimated on occurrence fine petechial haemorrhages on the limited skin area in a place of the dosed mechanical pressure. It is known, that ascorbic acid, being the aid donor of free radicals, provides proline hydroxylation and oxyproline formation, participating in collagen formation and intercellular endothelium substances of capillaries (*see methodical recommendations «Hygienic estimation of organism provision with vitamins A and C»*).

#### **Skin and mucous membranes of nasopharynx immunologic resistency studying**

Immunologic reactance changes are one of early and sensitive demonstration of influence of inadequate, unbalanced nutrition, and the immunity condition is considered as one of significant criteria of nutrition status. To revealing a degree

of nonspecific resistency infringement are applied immunologic methods by definition *superficial skin automicroflora*, *saliva bactericidal activity*, *saliva lysozyme activity*. *Automicroflora* definition is carried out with the help bacteriological test, thus calculation of total colonies on beef-extract agar (BEA), quantities mannitol decomposing staphylococcus culture (Korostelev nutrient medium) is carried out. Bactericidal activity of a saliva (BAS) in the relation gram-negative bacteria *E.coli* and lysozyme activity (BAL) in the relation gram-positive bacteria *Micrococcus lisodeicticus* is defined with the help photonephelometric method. Immunity condition is indirectly estimated on frequency of acute respiratory diseases among surveyed for previous year.

### ALGORITHM FOR STUDENT'S WORK:

1. To define somatic type with method constitution typing (*table 1*).
2. To measure the basic somatometric parameters (*Broka's Index*, *Kettle's Index*).
3. To define physiometric and functional parameters, and also adaptive reserves, which characterize nutrition status (*waist circumference*, *fat and lean (active) body weight*, *waist-hip ratio*, *force index*, *factor of endurance*, *vital index*, *parameter of heart activity*, *parameter of reaction heart-vascular system*, *index of stability to hypoxia*).
4. To acquaint with estimation methods of protein, vitamin and mineral provision organism and immunologic resistance condition (*look methodical recommendation «Hygienic estimation of organism provision by vitamin A and C»*).
5. Finding to enter in the protocol «*Hygienic estimation of nutrition status*». To estimate the nutrition status and to give recommendation on it optimization.

### Protocol

#### «Hygienic estimation of nutrition status»

	Parameter	Physiologic norms	Actual value	Deviation
Entrance of nutrients	1. Energy value, kcal			
	2. Proteins, g			
	3. Fats, g			
	4. Carbohydrates, g			
Structure Functions	Broka Index, kg/cm	1		
	Index Kettle (IBM), kg/m <sup>2</sup>	19,2–24,3		
	Skinfold thickness, mm	7–20		
	Fat content in body, %	9,0–19,5		
	Force index	look the table		
	The parameter of heart activity	0,1–15		
	Vital index, ml/kg	M-> 60; W-> 50		
	Parameter of heart-vascular system reaction	> 15%		
	Gench's Test: breath-delay time, sek	30 and more		
	Gench's Test: Index of stability to hypoxia	≤ 1		
Adaptation	Adaptation potential	≤ 2,6		
	Morbidity (number of acute respiratory diseases during year)	less then 4 time in year		

**Type of nutrition status** \_\_\_\_\_

Recommendations on optimization of nutrition status\*:

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*\*Notice: for body mass stabilization (at its excess or deficiency) it is necessary to increase (decrease) energetic value of diet on rating.*

*The increase of body mass on 1 kg corresponds to excess of food intake with calorificity 6800 kcal. Consequently, daily diet correction for month will compose:  $6800 \text{ kcal} / 30 \text{ day} = 227 \text{ kcal/day}$ .*

### **TOPIC 3: HYGIENIC ESTIMATION OF HARMLESSNESS OF NUTRITION**

**Total time:** 4 hours

#### **URGENCY OF TOPIC**

Sanitary inspection of nutrition includes research both an actual nutrition, and the harmless of nutrition. Studying of the harmless of nutrition has the important value for prevention of poisonings, conditions caused by an inadequate and unbalanced nutrition connected with the counterfeited foodstuff. At detection of attributes of infringements they are removed from food preparation process by prohibitions of sanitary doctor.

#### **THE PURPOSE**

To learn principles of sanitary conditions investigation on food industry objects, to give hygienic recommendations for risk factors removing in nutrition.

#### **PROBLEMS**

To learn to estimate the sanitary conditions of food industry objects by basic methods.

#### **VOLUME OF INDEPENDENT WORK**

Using a teaching material students should carry out examination of eating establishments, to give sanitary conclusion, recommendations.

#### **THE BASIC EDUCATIONAL QUESTIONS**

1. Definition of food poisonings. The general attributes of food poisonings.
2. Classification of food poisonings.
3. Toxocoinfection. Aetiology, clinic. Conditions necessary for occurrence of toxocoinfection. Preventive measures.
4. Aetiology of food intoxications.
5. Staphylococcal toxicosis, clinic, aetiology, preventive maintenance.
6. Botulism, clinic, epidemiology, preventive maintenance.
7. Mycotoxicosis. Aetiology, clinic and preventive maintenance.
8. Poisoning with mushrooms. Clinic and preventive maintenance.
9. Poisoning with products animal and vegetable. Their features and preventive maintenance.
10. The order of investigation of the food poisonings, necessary documents.

#### **AUXILIARY MATERIALS ON A THEME**

*Food poisonings are acute (less often chronic) non-contagious diseases arising as a result of food consumption, massive contaminated by microbial toxin or substance not microbial origin.*

**Food poisonings are characterized by a lot of the common attributes:**

- As a rule, the acute, sudden beginning of disease;
- single-stage the beginnings of disease;
- for the majority of food poisonings — acute short current of disease;
- connection of disease with consumption any one foodstuff or a dish;
- territorial limitation of disease by place of consumption or acquisition of a product;
- the extinction of new case occurrence of disease after withdrawal of «guilty product»;
- absence of transfer of food poisoning causal factor from the sick person to healthy man.

The purpose of sanitary-and-epidemiologic investigation of food poisoning are finding-out of the reasons and circumstances of its occurrence, creation and carrying out in life of rational expedient measures on liquidation and preventive maintenance of poisonings of similar character.

*In a basis of classification of the food poisonings two principles are put: etiology and pathogenetic.*

**On etiology principle food poisonings are shared on 3 groups:**

- Microbic.
- Non-microbic.
- Undetermined cause.

**Food poisonings of microbic etiology by pathogenetic principle share on 3 groups:**

- Toxocoinfection.
- Toxicoses (microbic and mycotoxicoses).
- Poisonings mixed etiology.

**Food poisonings non-microbic etiology share on 3 groups:**

- Poisonings with poisonous plants and fabrics of animals.
- Poisonings with plants and fabrics of animals, poisonous at defined conditions.
- Poisonings with chemical substances.

All cases of diseases with the diagnosis «food poisoning» should be investigated and registered necessarily in special magazines of Center of Hygiene and Epidemiology (CHE).

Sanitary-and-epidemiologic investigation by the standard technique is carried out (table 1).

Table 1 — Algorithm of investigation of food poisoning flash  
(for experts of sanitary-and-epidemiologic service)

The emergency notice about infectious disease, food, acute professional poisoning, unusual reaction to the inoculation		
1 stage	Confirmation of preliminary epidemiological diagnosis of food poisoning and finding-out of its character	Communication with doctor (definition of quantity patients, time and circumstances of occurrence of flash. The selected material for research)
		Specification of clinic of diseases and «guilty product» (interview of patients)
2 stage	Establishment of the reason of food poisoning	Collecting and laboratory research of material: the rests of suspected food; vomit mass, washing waters, excrement and urine of victims; blood for hemoculture reception for serologic reaction; slime from a pharynx and nose, from pustular skin defeats; scrapes and washouts from stock, the equipment, container, hands of the personnel; potable water from decanters, drinking reservoir, tanks, etc., at lethal outcomes contents of a stomach, intestines, parenchymatous organs, etc.
3 stage	Decoding of the mechanism of acquisition, by products, (a culinary product) pathogenic and toxic properties	Poisoning of the microbic origin
		Source of the infection
		Ways and factors of transfer of microorganisms
		The conditions promoting duplication and formation toxin of microorganisms in a product
		The conditions which have provided safety of microorganisms and toxins in products during processing
		Poisoning of non-microbic origin
		Etiologic connection of a «guilty» product with the arisen disease
4 stage	Actions on liquidation of food poisoning	Neutralization of dangerous in epidemic relation products (removal from realization or establishment of realization conditions of «guilty product»)
		Isolation of a pathogen source (dismissal from work or transference in other work)
		Interruption of pollution ways of foodstuff by pathogen of food poisonings (time or constant prohibition of object operation, its repair, carrying out of disinfection)
		The prevention of microorganisms reproduction and toxin formation (temperature conditions and periods of perishable food storage, hygiene of technological process of manufacturing, process-sing and realization of food and culinary products)
5 stage	Drawing up of the act of investigation	Passport part
		Finding part
		Final part
		Preventive actions (operative, perspective)
		Sanctions of sanitary inspection

Laboratory researches are carried out according to «Instruction on the order of investigation, the account and carrying out of laboratory researches in establishments of sanitary-and-epidemiologic service at food poisonings».



## **Drawing up of the act of food poisoning investigation**

### **The act of investigation of food poisoning consists of five parts**

1. A passport part: specify, who carries out investigation (surname, a post), together with whom, at the presence of whom, date of drawing up of the act.

2. Finding part: in which are resulted:

a) the detailed description of the beginning of disease, its date, number of the arrived patients during the first 3–4 h. And then in the next hours and days; specify, whether was similar diseases in previous days. Describe a detailed clinical picture of patients (table 3, 4), intensity of diseases, preliminary diagnosis. Mark the common pattern of suspected products, number of victims (a surname, a name, a sex, age), number of hospitalized persons, died (name, with the indication of the same data). Are stated all circumstances connected to occurrence of food poisoning;

b) specify, what materials are taken from patients (washing waters, emetic, excrement mass, blood and other), from what patients and where are directed for laboratory research (table 5);

c) specify a place of food consumption or purchase of foodstuff: describe in detail the menu for the last 48 h (table 2). Before occurrence of poisoning symptoms, and also the menu not injured, but eating simultaneously with victims in the same dining room, buffet, etc., through what is the time after reception of food have appeared attributes of disease. Write down opinion on a product caused food poisoning, the reason of product pathogenicity and toxicity, own reasons. Result of estimation by fallen ill persons of organoleptic properties of the foodstuff which has served by the reason of food poisoning, quantity of the eaten product, etc. Bring the data on a place of manufacturing and time of reception of the given product, presence of certificates, the veterinary certificate, waybills, ways of its movement, the sanitary characteristic of a product at the moment of investigation;

d) give the brief description of a sanitary condition of the enterprise food.

The industries or the public catering establishment which have produce product, technological process, sanitary conditions of manufacturing of this product, a storage condition, realization, transportation, storage of raw material (the detailed act of sanitary inspection of the enterprise is applied separately) in detail describe. Specify what products and where are directed on laboratory research.

e) place the data of chemical and bacteriological laboratory research, and also pathologic researches of a cadaveric material.

3. Final part — conclusion. Give substantiation, confirming the fact of food poisoning: specify what product was by the reason of food poisonings, an etiology (microorganisms, poison, etc.), a source of the reason promoting flash, etc.

4. Preventive actions:

a) operative — are carried out on object;

b) perspective — with the purpose of the prevention of similar diseases in further.

5. Sanctions of sanitary inspection: in relation to the enterprise and guilty to the persons promoting occurrence of flash.

Table 2 — The circuit of interrogation for finding-out of the common product at group food poisoning

№	First name, last name	The food product name and intake date					
		Product					
		Cutlet meat	Fish in marinade	Cottage cheese with sour cream	Fritters with meat	Date	Date
		Date	Date	Date	Date		
1		+	+				
2		-	+	+			
3		-	+				
4		+	+				
5		+	+				
6		-	+	+	+		
7		-	+				
8		+	+				
9		-	+		+		
10		-	+				

Table 3 — The circuit of the analysis of disease symptoms

Name, surname of the patient	Date, time of the disease beginning, date of hospitalization	The basic symptoms																															
		n	v	d	c	a	t	h	w	d	p	m	d	a	v	c	m	j	b														
		a	o	i	o	b	e	e	s	t	y	r	g	o	o	n	s	i	l	o	d	y	e	x	c	r	e	m	e	n	t	s	
		u	m	r	s	m	a	a	o	r	d	r	l	i	c	v	u	s	n	o	d	y	e	x	c	r	e	m	e	n	t	s	
		s	i	t	t	i	r	k	d	e	r	a	u	c	e	l	s	w	e	a	i	n	c	r	e	m	e	n	t	s			
		e	n	g	h	e	p	a	t	i	o	n	p	a	n	g	e	s	n	e	s												
		a	g	a	p	a	t	i	o	n	p	a	n	g	e	s	n	e	s														

Table 4 — Some clinical symptoms at food poisonings of the bacterial origin

Clinical symptoms	Salmonella	Shigella	Enteropathogenic serotypes of gr. Escher. Coli	Staphylococcus	Clostridium Botulini
The incubatory period	6–24 h	3–5 day	4–10 h	6–24 h	4–18 h norm
Temperature	High	High	High	High	Seldom
Fever	++	+	+ –	+ –	–
Nausea	+	+	+ –	+ –	++
Vomitting	+	++	+ –	+ –	– +
Pains in epigastric areas	+ –	+ –	+ –	+ –	+ –
Pains in the field of stomach	+++	+++	++	++	– +
Diarrhea	+++	+++	+++	+++	–
Bloody excrement	– +	+++	– +	– +	–
Excrement with slime	– +	+++	+	+	–
Constipation	–	–	–	–	+
Meteorizm	–	–	–	–	+
General weakness, dizziness	+++	++	++	++	+
Headache	+++	+++	+ –	+ –	+++
Frustration of vision, diplopia, ptosis, mydriasis	–	–	–	–	++++
Speech, swallowing disturbance,	–	–	–	–	++
Dryness in a mouth	–	–	–	–	+
Loss of consciousness	– +	+ –	– +	– +	– +
Spasmes	– +	+ –	– +	– +	– +
Collapse of heart activity	– +	– +	– +	– +	+++
Frustration of breath	–	–	–	–	+++

Table 5 — The objects which must be directed in laboratory and researched

The name of the material	Quantity of material	Time of material taking out
Foodstuff		
The rests of suspected food	50–500 g	1-st day
Tests liquid or semi-liquid dishes or products (soups, sauces, creams, a pier. products)	After careful hashing of 200 ml	The same
The second dishes	1–2 portions	The same
Meat from various places (it is necessary lymph, nodus and a site of a tubular bone)	500 g	The same
Meat products from various places	500 g	The same
Brine from butt with salty products	100–200 ml	The same
Bird (the whole poultry, the rests, anal aperture)	1–2 pieces	The same
Fish: from large from 2–3 pieces, from back is closer to a head, to anal aperture	500–600 g	The same
Canned food: opened banks	All	The same
Not opened banks of the same autoclaving	5–10 pieces	The same

The name of the material	Quantity of material	Time of material taking out
Washouts and scrapes from stock, the equipment		
Washouts from hands, and in necessary cases smears from pharynx and a nose of the personnel occupied with food manufacturing		1-st day
Research of the personnel on carrier state of intestinal infections		The first days after food poisoning
Objects of research from fallen ill, vomitting mass	50–100 g	1-st day
The first washing waters	100–200 ml	The same
Faecal mass	50–100 g	The same
Urine	20–30 ml	The same
Blood for crop	8–10 ml from a vein	The first hours or day of disease
Blood for serological researches	2–3 ml from a finger	For 1-3 day and 7-10 day or 15-20 day of disease
Section material the maintenance of a stomach, a piece of thin and thick guts, liver, spleen, blood from heart	50–60 g	The first hours after section

## **TOPIC 4: HYGIENIC ESTIMATION OF ORGANISM PROVISION BY VITAMINS A AND C.**

**Total time:** 4 hours

### **URGENCY OF TOPIC**

Functioning of systems endogenous homeostasis protection and current of all physiological processes depends on adequacy and equation of actual nutrition, organism provision by essential nutrients, including vitamins. Vitamin insufficiency, first of all A and C, promotes change of optimal assimilation conditions of food substances, infringement of enzymatic catalysis mechanisms and biochemical processes of all vital organism functions that is adversely reflected in formation of the nutrition status. Therefore, hygienic estimation of organism provision by retinol and ascorbic acid allows to diagnose a hypovitaminosis condition and to prevent avitaminosis development.

### **THE PURPOSE**

To systematize and fix knowledge about the hygienic and biological importance of vitamins A and C. To acquaint students with the basic techniques of hygienic estimation of organism provision by retinol and ascorbic acid.

### **PROBLEMS**

- To master techniques of a hygienic estimation of organism provision by retinol and ascorbic acid.
- To master the decision of situational tasks on pre-nozological hygienic diagnostics of hypovitaminosis conditions.

### **REQUIREMENTS TO AN INITIAL LEVEL OF KNOWLEDGE**

It is necessary to repeat from:

- *Biochemistry*: what is the vitamins; participation of the basic water-and fat-soluble vitamins in biochemical reactions of an organism.
- *Physiologies*: physiological role of vitamins.

### **CONTROL QUESTIONS FROM ADJACENT SUBJECTS**

- 1) Definition and classification of vitamins.
- 2) Pro-vitamins. Antivitamins.
- 3) Exogenous and endogenous reasons of hypo-and avitaminosis.
- 4) Daily needs in the basic water-and fat-soluble vitamins.
- 5) A biochemical and physiological quality monitoring of organism provision by vitamins.

### **THE BASIC EDUCATIONAL QUESTIONS:**

- 1) The reasons of vitamin insufficiency development.
- 2) A biological role of ascorbic acid.
- 3) Displays of vitamin C insufficiency.
- 4) A biological role of vitamin A.
- 5) Attributes of A-hypovitaminosis.

- 6) Physiological needs of the basic vitamins.
- 7) Products - sources of an ascorbic acid, carotin and retinol.
- 8) Hypervitaminosis: the reasons and prophylaxis.

### AUXILIARY MATERIALS OF THEME

The food is the energy source for numerous processes of live ability and serves as the supplier of plastic materials, and irreplaceable nutrients for construction of structural elements also, realization of enzymatic catalysis mechanisms and metabolism regulation. One of irreplaceable nutrients are *vitamins* — the low-molecular organic compositions necessary for homeostasis support, normal metabolism realization, biochemical maintenance of all vital organism functions.

Vitamins are not a plastic material or energy source and are included in a metabolism mainly as biocatalysis participants (*catalytic vitamin function*) and regulation of biochemical and physiological processes (*regulative function*).

The control over sufficient receipt with food of vitamins and satisfaction of physiological needs in them is one of the major tasks of general hygiene experts.

There are two basic *groups of methods for estimation of organism provision by vitamins*:

1. Studying of the vitamin content in diets of investigated contingents of the population and actual vitamins consumption with food.
2. Studying and estimation of vitamin status of the person on a level of functioning adequacy of physiological and biochemical systems, whose essential components are the given vitamins.

The first group of methods sets task to receive data about quantity of the vitamins incoming in organism of the person with food, without taking into account specific features of physiological and metabolic processes.

The second group of methods allows to reveal a degree of organism saturation by vitamins.

The basic approaches to vitamin provision estimation of the person are represented in table 1.

Table 1 — Methods of studying of organism provision by vitamins

<i>Studying of vitamin value of diets and actual consumption of vitamins with food</i>	<i>Studying of the vitamin status of organism</i>
Methods of actual nutrition studying: — biographical-polling; — calculation; — weight. Chemical-analytical methods of vitamins content definition in diets.	<ol style="list-style-type: none"> <li>1. Somatometric methods;</li> <li>2. Physiometric methods;</li> <li>3. Clinical and somatoscopic inspection with vitamin insufficiency microsymptoms revealing (hypo- and avitaminosis)</li> <li>4. Physiologic-and-biochemical tests (direct and functional);</li> <li>5. Hematologic methods;</li> <li>6. Immunologic methods;</li> <li>7. Studying of morbidity.</li> </ol>

The most significant for human organism are vitamin C and A. Therefore hygienic estimation of vitamin provision by the given vitamins is an actual task nutriology.

### **I. Studying vitamin value of diets and actual consumption vitamin A and C with food**

*The calculation method* consists in studying a grocery set consumed by the person under official documents (menus-allocations, memory sheets) with the subsequent calculation under tables of «the Chemical compound of foodstuff» contents in them of vitamins A and C. The data received with the help of this method, give representation about vitamin value of a used diet, about the basic food vitamin sources of nutrition of the population. However they do not allow to take into account true consumption of vitamins as the account of food really eaten with them is absent. This defects are absent in weight and, in a smaller measure, biographical-polling methods.

*The biographical-polling method* consists in studying an actual nutrition of the population with the help of specially developed questionnaires. The method is simple, accessible, does not demand the special equipment and can be used at the analysis both group, and an individual nutrition in domestic conditions. For an estimation of vitamin security in questionnaires include questions on consumption within day of additional sources of vitamins — polyvitamins, vitaminized drinks, etc.

*The weight method* consists in the strict quantitative account (weighing) all products consumed in day and dishes. The method is toilful, but enables a full quantitative estimation of actual nutrition.

At the analysis of vitamins consumption with food it is necessary to take into account their disintegration at culinary and thermal treatment of products. For example, destruction of vitamin A makes from 5% (baked pudding and cottage cheese pudding) up to 63–67% (boiled hen); and ascorbic acid disintegration — from 15% (potatoes boiled in their jackets) up to 100% (meat boiled) (**appendices 1–2**).

Using the described methods, data on the vitamins content in daily average diets and their actual consumption are got. This data are compared with norms of daily average physiological need for vitamins (2006) (**the appendix 3**).

Data on vitamins contents at application of calculation method have approximate character that is caused by acute fluctuations of vitamins content in the same products depending on climatic and geographical conditions, season, a grade, period of storage, the subsequent culinary and thermal treatment, etc. factors. These lacks are deprived direct methods of definition of the vitamins contents, based on use of *chemical-and-analytical techniques*.

### **II. Studying the vitamin status of an organism**

#### ***a) Health state and physical development estimation***

The complex studying of a health state including total clinical examination, estimation of morbidity, studying of immunological status and anthropometrical parameters, is the important estimation of organism provision by vitamins.

*Total clinical and somatoscopy examination* is directed on revealing of possible hypovitaminosis microsymbptoms (**the appendix 4, 5**).

One of the basic parameters describing health state is *the morbidity studying* including *the general number of cases with time disability, studying of structure of morbidity, calculation of an health index of collective* (number surveyed, not addressed for medical aid /the general number surveyed  $\times 100\%$ ).

Deviations of *anthropometrical parameters* from standard parameters of physical development of healthy persons can specify also deficiency in nutrition of the vitamins, playing the important role in maintenance of normal growth and development.

*Immunologic and hematologic status* parameters are sensitive tests which can change at earlier stages of vitamin insufficiency, than other parameters of health.

#### **b) Physics- and -biochemical tests for estimation of vitamins provision**

The essence of these methods consists in direct studying the content of vitamins and them metabolits in biological liquids (*biochemical tests*), or in an estimation of physiological or metabolic processes which realized with vitamins help (*physiological tests*).

##### **Physiological tests:**

1. Research of vessels wall permeability (estimation of provision by ascorbic acid and bioflavonoids) (**the appendix 6**).

2. Estimation of dark adaptation time (as a parameter of organism provision by retinol).

The method consists in studying a threshold of dark adaptation, representing the minimal illumination intensity which perceives surveyed after stay in darkness. At infringement of organism provision by retinol the threshold of dark adaptation raises.

Alongside with studying dark adaptation can be used electroretinography.

##### **Biochemical tests:**

1. The methods based on definition of the vitamins and products of their metabolism in biological liquids of organism, tissues.

a) Definition of vitamin C in blood whey, leukocytes, urine.

Provision of an organism by vitamin C judge by quantity of the ascorbic acid exude with urine (mg/hour or daily exude) (**the appendix 7**); under the relation of quantity of an ascorbic acid is exuded with urine to quantity egest general nitrogen (norm 0,21–0,33); under the content in blood whey and leukocytes (norm 0,7–1,2 in 100 ml);

b) Research of the vitamin A content in blood (on an empty stomach and after loading vitamin A).

In norm the content retinol in blood 1,05–2,44 mkmol/l, carotinoids — 1,5–4,6 mkmol/l. Lower numbers specify about retinol deficiency in a diet.

c) Methods of an estimation of vitamin A reserve in a liver.

2. The methods based on an estimation of a condition of metabolic processes in which take part vitamins.



a) Studying vitamin A-dependent physiological and metabolic processes, including biomicroscopy of a cornea.

b) Studying of praline-hydroxylase activity and oxipraline excretion with urine (reflection of vitamin C participation in praline hydroxylation processes).

**The daily need** in vitamin A the adult person makes from 800 up to 1000 mkg retinol equivalent. Thus 1/3 should become covered for the account retinol and 2/3-due to carotin. The need for adults an ascorbic acid pays off on 1 Mcal (on 1000 kcal is necessary receipt 25 mg of vitamin C). For children the norm of consumption of vitamin A and C are specified in **the appendix 3**.

**Foodstuff — sources of vitamin C** under the content of an ascorbic acid share on 3 groups: 1 group with the vitamin C content higher 100 mg%; 2 group with the vitamin C content from 50 up to 100 mg%; 3 group — the vitamin C content less than 50 mg% (table 2).

Table 2 — Products - sources of vitamin C

<b>Group of products</b>	
I. The content of vitamin C higher 100 mg%	Dogrose (dry fruit) (1500), black currant (250), pepper red sweet (250), sea-buckthorn berries (120), Brussels sprouts (120), fennel (150), parsley (150), a horse-radish (200)
II. The content of vitamin C from 50 up to 100 mg%	Cabbage red (60), cauliflower (70), strawberry (70), grapefruit (60), dock (55)
III. The content of vitamin C up to 50 mg%	<i>Vitamin-carriers of average activity (up to 50 mg%):</i> white cabbage (30), citrus (40–50), apples (16), a green peas (25), tomatoes (22), a gooseberry (45), raspberry (37), potato (20–30); <i>vitamin-carriers of weak activity (up to 10 mg%):</i> carrots (5), cucumbers (9), beet (10), water-melon (7), pomegra-nates (5)

**The content of vitamin A and carotin** in some food stuffs is resulted in table 3.

Table 3 — The content of vitamin A and carotin in food stuffs

<b>The content of vitamin A, mg%</b>		<b>The content of carotin, mg%</b>	
Fat of a liver crashes	19,0	Pepper red	10,0
Beef liver	14,0	Carrots red	8,0
Pork liver	6,0	Onion green	4,8
Liver crashes	3,3	Dogrose	8,0
Eggs	0,6	Apricots dried	5,0
Oil creamy	0,3	Apricots fresh	1,72
Cream, sour cream	0,3	Tomatoes red	1,7
Milk	0,05	Currant black	0,7

## 10. The task for independent work of students

1. To estimate a daily grocery set taking into account the content in it ascorbic acid and vitamin A (see results of the previous practical class on theme: «the Hygienic estimation of nutrition adequacy»), data to enter in the minutes (the appendix 8).

2. To carry out somatoscopic inspection for definition of microsemiology of vitamin insufficiency (the appendix 4, 5).

3. To define capillaries resistency (the technique of carrying out is stated in the appendix 6).

4. To determine mg/hour excretion of an ascorbic acid with urine. To estimate the nutrition status on a degree of organism provision by vitamin C (the appendix 7).

5. To determine the maintenance of an ascorbic acid in dogrose extract. To calculate for itself necessary quantity given extract for completion of daily need for vitamin C (at absence of other sources of an ascorbic acid).

### 11. Self-checking mastering a theme

The independent decision of situational tasks (**the appendix 9**). Being based on the received knowledge to put and prove the diagnosis of the disease connected to vitamin insufficiency; to calculate need and to estimate sufficiency of the maintenance of vitamins A and C in diets; to give recommendations on optimization of an actual nutrition.

## THE APPENDIX 1

### Loss of food substances at the basic types of thermal culinary processing, % (the Chemical compound of foodstuff. Directory / under red. I. M. Skurihin, M.N.Volgarev, 1987)

Products	Vitamins					
	A	$\beta$ -carotin	B <sub>1</sub>	B <sub>2</sub>	PP	C
Boiling						
Vegetative						
Without pouring	–	10	15	10	15	60
With pouring	–	15	30	20	25	80
Meat	50	–	45	40	20	70
Fish	35	–	45	40	30	90
Roasting						
Vegetative	–	25	30	10	15	45
Meat	40	25	25	15	15	60
Fish	20	–	20	20	15	35
Cutlets from meat	20	–	10	10	10	80
Stewing						
Meat	15	15	30	20	15	70
Quicken pace						
Vegetative	–	15	20	20	20	65
Fish	25	–	30	20	20	85
Browning						
Vegetative	–	8	15	15	15	60

## THE APPENDIX 2

### The generalized sizes of food substances losses at thermal culinary products processing, %

Products	Vitamins					
	A	$\beta$ -carotin	B <sub>1</sub>	B <sub>2</sub>	PP	C
Vegetative	–	20	25	15	20	60
Animal	40	–	35	30	20	60
Average	40	20	28	20	20	60

## THE APPENDIX 3

### Norms of physiological needs in vitamins for children and adolescents (USSR, №5786-91)

Parameters	6 years	7–10 years	11–13 years, boys	11–13 years, girls	14–17 years, young men	14–17 years, girls
Vitamins						
A, mkg retinol. equ.	500	700	1000	800	1000	800
E, mg toopherol. egu.	10	10	12	10	15	12
D, mkg	2,5	2,5	2,5	2,5	2,5	2,5
<b>B<sub>1</sub>, mg</b>	1,0	1,2	1,4	1,3	1,5	1,3
<b>B<sub>2</sub>, mg</b>	1,2	1,4	1,7	1,5	1,8	1,5
<b>B<sub>6</sub>, mg</b>	1,3	1,6	1,8	1,6	2,0	1,6
Niacin, mg niacin.egu.	13	15	18	17	20	17
Folat, mkg	200	200	200	200	200	200
B <sub>12</sub> , mkg	1,5	2,0	3,0	3,0	3,0	3,0
W, mg	60	60	70	70	70	70

## THE APPENDIX 4

### Somatoscopic attributes of nutrition insufficiency

Attributes	Vitamins						
	A	B <sub>1</sub>	B <sub>2</sub>	PP	B <sub>6</sub>	C	PP
1. General weakness	+	+	+	+	+	+	+
2. Fast fatigue intellectual and physical	+	++	+	++	+	++	+
3. Pains in muscles of legs at walking	–	+				++	+
4. Disorder of sleep		+	+	++	+		
5. Dyspnea at movement		++	+	±		+	+
6. Deterioration of appetite		++					
7. Dryness of skin and peeling	++					++	++
8. Pallor of skin	+	+	+		+	++	++
9. Skin cyanosis	±	±	±		+	++	+
10. The raised secretion of sebaceous glands (wings of a nose, forehead, lobe of the ear)	±	++	+	+			
11. Petechial hemorrhage, gingival hemorrhage						++	++
12. Skin hyperkeratosis in areas elbow and knee joints	++			++			

Attributes	Vitamins						
	A	B <sub>1</sub>	B <sub>2</sub>	PP	B <sub>6</sub>	C	PP
13. Keratinization hair follicles (follicular hyperkeratosis)						++	++
14. Brown pigmentation (cheek-bones, eye sockets)				++			
15. Skin depigmentation						±	±
16. Dryness of conjunctiva, cornea	++		+				
17. Epithelium desquamation in corners of eyes	+		±				
18. Cornea vascularization («red eye»)			++				
19. Angular stomatitis	±	±	++	+	±		
20. Painful vertical cracks of lips	-	+	++	++	++	-	-
21. Epithelium desquamation on a line lips joining, internal lips surface is bright-red (cheilosis)		±	++	+	+		
22. Gums atrophy, neck of tooth exposure						++	++
23. Tongue edema, marks of a teeth on it, lingual papilla hypertrophy («geographical tongue»)		+	+	++	+		
24. Epithelium desquamation of lingual papilla, red tip ton.		+	+	++	+		
25. «Lacquered» tongue:							
— scarlet		+	+	++	+		
— fuchsin		+	++	+	+		
26. Nails: — «spoon-shaped» depression, striatura, foliation	++						

## THE APPENDIX 5

### SOMATOSCOPIC ATTRIBUTES OF VITAMIN INSUFFICIENCY (description of the basic clinical symptoms)

***Hydropic loosening and gingival hemorrhages*** – on gums is present a bright-red or cyanotic border. Gums swell, papilla between teeth become hydropic. At pressing on gums appear hemorrhages.

***Follicular hyperkeratosis*** — it is characterized by presence on extensor surfaces of hands, hips in area funnel of hair follicles the amplified epithelium cornification and formation nodules eminent above the skin surface. The skin becomes rough — «goose skin». Follicular hyperkeratosis, caused by retinol deficiency, it is accompanied by skin dryness (as a result of functions relief of sebaceous and sweat-glands), keratinized epithelium around of hair follicles hardly it is scraped off. Follicular hyperkeratosis, caused by ascorbic acid deficiency, comes out of capillaries permeability infringements of hair follicles and in the expressed cases it can be accompanied by small dot haemorrhages, which give to nodules blue-purple color. At that keratinized epithelium around hair follicle is easily scraped off and under it papula red color are exposed.

***Skin hyperkeratosis*** — it is characterized by presence on extensor surfaces, especially in elbow and knee joints areas, papular rashes and a peeling.

***Angular stomatitis*** is shown pale mucous membrane of lips in the field of mouth angles which then starts to become wet. Epithelium is macerated and peeled,

the cracks are formed, which are covered by yellowish, easily removed crusts after which remain ulcers. After crack healing the white superficial scar is formed.

***Papilla tongue hypertrophy, «geographical tongue»*** — result of vessels expansion and subsequent blood stagnation in tongue papilla, with the subsequent epithelium peeling of hypertrophied papilla. As a result of it at first becomes red tip tongue, in more expressed cases tongue becomes crimson. Tongue becomes edematic, on lateral tongue surfaces there are teeth marks. In neglected cases develops desquamative glossitis («geographical tongue»).

On the increased in volume tongue there are longitudinal and cross cracks.

## **THE APPENDIX 6**

### **RESEARCH OF SKIN CAPILLARIES RESISTENCY (SCR)**

SCR depends on organism provision by ascorbic acid and rutin which participate in regulation colloid condition of intercellular substances.

This parameter is estimated on occurrence of fine haemorrhages on the limited place of skin under mechanical action (creation of superfluous or negative pressure).

Having naked a forearm, on the proximal third of shoulder is overlaid cuff of tonometer. In a cuff is created pressure in 200 mm. mercury within 3 minutes. SCR is estimated on a site of dosed out loading on skin capillaries. (under cuff). Haemorrhages are counted up with the help of magnifier. For hyperemia prevention the research site need gently to squeeze by object-plate. SCR is estimated on a five-marks scale:

I level — up to 5 fine petechia;

II level — from 6 up to 15;

III level — up to 30;

IV level — more than 30 haemorrhages;

V level — the number of haemorrhages aren't beyond all calculation, confluent reaction.

At sufficient provision C and P-vitamin at practically healthy people it is usually registered I and II level of SCR.

## **THE APPENDIX 7**

### **ESTIMATION OF ASCORBIC ACID EXCRETED WITH URINE (MG/ HOUR)**

Practically healthy 18–23 years persons at sufficient C-vitamin provision excrete ascorbic acid with urine on an empty stomach from 0,7 till 1,0 mg / hour. Reduction of the given parameter till 0,3 mg / hour and less testifies to sharp reduction of «metabolic fund» vitamin C in organism and is usually shown by visible hypovitaminosis symptoms.

**Estimation of the nutrition status on organism  
provision by vitamin C**

The nutrition status	Usual	Optimal	Superfluous	Insufficient		
				Deficient	Pre-morbid	Morbid
Vitamin C excretion	0,5–0,6	0,8–1,2	> 1,2	0,3–0,5	0,3–0,2	<0,2

**THE APPENDIX 8**

**Estimation C and A-vitamin provision of an organism**

№	Parameter	The physiological norms	Actual mean	Presence of hypovitaminosis attributes	
				A	C
1	<i>Receipt of vitamins in structure of diets:</i> — vitamin C; — vitamin A.				
2	<i>Microsymptoms of vitamin insufficiency (to write out only revealed):</i>	—	—		
	1. General weakness				
	2. Fast fatigue intellectual and physical	—	—		
	3. Pain in muscles of legs at walking	—	—		
	4. Deterioration of dream	—	—		
	5. Dispnea at movement	—	—		
	6. Deterioration of appetite	—	—		
	7. Skin dryness and a peeling	—	—		
	8. Pallor of a skin	—	—		
	9. Skin cyanosis	—	—		
	10. The raised secretion of sebaceous glands (wings of a nose, forehead, lobe of the ear)	—	—		
	11. Petechial hemorrhage, gingival hemorrhage	—	—		
	12. Skin hyperkeratosis in areas elbow and knee joints	—	—		
	13. Keratinization hair follicles (follicular hyperkeratosis)	—	—		
	14. Brown pigmentation (cheekbones, eye hollows)	—	—		
	15. Skin depigmentation	—	—		
	16. Dryness of conjunctiva, cornea	—	—		
	17. Epithelium desquamation in corners of eyes	—	—		
	18. Cornea vascularization («red eye»)	—	—		
	19. Angular stomatitis	—	—		
	20. Painful vertical cracks of lips	—	—		
	21. Epithelium desquamation on a line lips joining, internal lips surface is bright-red (cheilosis)	—	—		

№	Parameter	The physiological norms	Actual mean	Presence of hypovitaminosis attributes	
				A	C
	22. Gums atrophy, neck of tooth exposure	–	–		
	23. Tongue edema, marks of a teeth on it, lingual papilla hypertrophy («geographical tongue»)	–	–		
	24. Epithelium desquamation of lingual papilla, red tip tongue	–	–		
	25. «Lacquered» tongue:	–	–		
	— scarlet	–	–		
	— fuchsin	–	–		
	26. Nails:				
	— «spoon-shaped» depression	–	–		
	— striatura, foliation	–	–		
3.	<i>Resistency of skin capillaries</i>				
4.	<i>Mg / hour excretion of vitamin C with urine</i>				

## THE APPENDIX 8

### Typical tasks

#### **Task № 1**

At hygienic analysis of an actual nutrition of the student (20 years, weight of 65 kg) are revealed, that vitamin C content in a diet (in view of losses at culinary processing) has made 25 mg/day, and vitamin A (in retinol equivalent) — 580 mkg. The student complained on the general weakness, fast fatigue, often respiratory diseases, gingival hemorrhages. At student's inspection are revealed skin hyperkeratosis on elbow bends, narrowing of a vision field, infringement of dark adaptation. Vitamin C excretion with urine has made 0,1 mg / hour.

- To estimate organism provision by vitamins C and A. To give the conclusion.
- To calculate daily need of this student for an ascorbic acid.
- To give recommendations on elimination of given symptoms of hypovitaminosis.

#### **Task № 2**

In a daily diet of the teacher (50 years, the weight of 65 kg) contains 180 g fresh cabbage. At absence of other sources of vitamin C, its content in cabbage made 50 mg / %. At culinary processing was lost on the average 60%. Vitamin C excretion with urine has made 0,3 mg / hour. Reduction of skin capillaries resistency is marked.

- To estimate the organism provision by vitamin C.
- To calculate daily need of the teacher for an ascorbic acid.

### **Task № 3**

The worker of confectionery factory (28 years, weight of 55 kg) has addressed to the doctor with complaints on feeling of weakness and pains in legs, fast fatigue of legs at walking. In conversation with the patient essential lacks of her nutrition have been established: the use of confectionery products daily, regular use in nutrition of a white bread from a flour of the premium, semolina porridge and porridge from the polished rice. At palpation morbidity икроножных muscles is revealed. Vitamin C excretion with urine has made 0,2 mg / hour. The increased skin capillaries fragility was revealed.

— At insufficient of what vitamin in a nutrition can be observed above mentioned semiology?

— To calculate daily need of the worker for an ascorbic acid.

— What correction it is necessary to bring in nutrition of the patient?

### **Task № 4**

The employee of bank (35 years, weight of 70 kg) has addressed to the doctor with complaints on increase at her respiratory diseases and sharp deterioration of ability to see subjects in twilight. In anamnesis it was found out, that the patient is severe vegetarian. At inspection it is revealed follicular hiperkeratosis and infringement of normal colour sensation.

— What hypovitaminosis condition picture did represent here? To prove the conclusion.

— What additional researches can be appointed the patient for diagnosis confirmation?

— To give recommendations on hypovitaminosis elimination.

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Учебное издание

**Золотарева Алла Викторовна**

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**(на английском языке)**

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**для зарубежных стран**

**Компьютерная верстка *А. М. Елисеева***

Подписано в печать 25. 06. 2007

Формат 60×84<sup>1</sup>/<sub>16</sub>. Бумага офсетная 65 г/м<sup>2</sup>. Гарнитура «Таймс»  
Усл. печ. л. 2,32. Уч.-изд. л. 2,5. Тираж 50 экз. Заказ № 188

Издатель и полиграфическое исполнение  
Учреждение образования  
«Гомельский государственный медицинский университет»  
246000, г. Гомель, ул. Ланге, 5  
ЛИ № 02330/0133072 от 30. 04. 2004

